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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
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W87-08601 -- W87-09601

The Secretary of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1988.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

DETERMINATION OF MONOMERIC AND POLYNUCLEAR ALUMINUM(III) SPECIES AND HYDROLYSIS CONSTANTS,
Ohio State Univ., Columbus. Water Resources Center.
P. L. Hayden, and A. J. Rubin.
Separation Science and Technology SSTEDS, Vol. 21, No. 10, p 1009-1024, December 1986. 3 fig, 4 tab, 33 ref.

Descriptors: *Aqueous solutions, *Aluminum, *Hydrolysis, Acidity, Ions, Complexes, Equilibrium, Precipitation, Computers.

Aqueous reactions of aluminum(III) were investigated in acidic aluminum solutions at fixed ionic strength and below the pH of precipitation. Computer analysis of potentiometric data for three concentrations (0.1, 0.5, and 1 mM Al) indicated that the experimental results could be explained by assuming only two principal hydrolyzed species, AlOH(2+) and Al8(OH)20(4+). No other combination of aluminum complexes appeared to fit the data as did these species. The equilibrium constant for the monohydroxy ion was very close to values determined by other methods. The refined values of the formation constants for *pK1 and p(beta)8.20 were 5.55 and 68.7, respectively, at an ionic strength of 0.15, and 5.11 and 64.1, respectively, at zero ionic strength. (Author's abstract)
W87-08611

2. WATER CYCLE

2A. General

LABORATORY EXPERIMENT ON THE ROLE OF GRASS FOR INFILTRATION AND RUNOFF PROCESSES,
Tokyo Inst. of Technology (Japan). Dept. of Civil Engineering.
M. Hino, K. Fujita, and H. Shutto.
Journal of Hydrology JHYDA7, Vol. 90, No. 3/4, p 303-325, April 1987. 13 fig, 2 tab, 11 ref.

Descriptors: *Rainfall-runoff relationships, *Lysimeters, *Infiltration, *Runoff, *Grasses, *Overland flow, *Groundwater movement, Roots, Evapotranspiration, Soil water, Rainfall.

Two lysimeters with the same dimensions were filled with the same loam clay to compare the hydrologic response of a grassed lysimeter with that of a bare soil lysimeter. About half of the runoff from the bare soil lysimeter occurred as overland flow, the rest being groundwater flow. Overland flow scarcely occurred from the grassed lysimeter. Grass roots that developed deep into the soil layer play an important role in increasing the infiltration rate as well as in drying the soil uniformly throughout the soil layer by evapotranspiration, preparing for high infiltration and large rainwater storage for the subsequent rainfall event. Accordingly, the total loss by evapotranspiration from the grassed soil amounts to almost twice that from the bare soil. For an evaporation- and evapotranspiration-prohibited experiment, the recession characteristics from a saturation state showed similar features for the bare and grassed soils, indicating the same microstructure of high moisture reservability for both soils. The well-developed grass root system reformed the soil structure considerably to produce the seemingly contradicting characteristics of high moisture conductivity and high moisture reservability; i.e. a high infiltration rate and prolonged groundwater discharge. Finally, the importance of the initial soil moisture in the rainfall-runoff process, rainfall loss and runoff ratio is stressed. (Author's abstract)
W87-08622

HYDROLOGY,
Finkel and Finkel, Yoqneam (Israel).
H. J. Finkel, and M. Finkel.
IN: Semiarid Soil and Water Conservation, CRC Press, Inc., Boca Raton, FL. 1986. p 5-26, 7 fig, 8 tab, 12 ref.

Descriptors: *Hydrologic studies, *Arava Valley, *Israel, *Mathematical studies, Rainfall-runoff relationships, Rainfall, Streamflow, Watersheds, Hydrographs, Runoff, Semiarid lands.

The hydrologic study of the Arava Valley is presented in some detail as an illustration of a method relevant to other similar regions of low rainfall, intermittent stream flow, and broken, hilly topography. General conclusions are: (1) If the average occurrence of floods from several nearby watersheds follows a Poisson distribution they may be considered as part of a single population, at least insofar as probabilities of flood occurrences are concerned; (2) Peak flows, Q sub max, whether long-term average annual or of any given probability of occurrence, generally follow the following relationship: Q sub max = K A to the b power, where K is a constant expressing the probability of recurrence, and b is an exponent closely approximating 0.6 to 0.7. Q-A curves on long-log paper for various probabilities will plot as a series of straight, parallel lines; (3) The relations between Q sub max and V, flood volume, have a high linear correlation because the flood durations vary over a relatively small range, and the hydrographs have a fairly standard shape factor; (4) For watersheds of widely varying catchment areas there was a fairly constant relationship between A sub max/Q sub avg, and the probabilities of occurrence; (5) The cumulative runoff from all of the 'point areas' represents the bulk of the water which begins as surface flow. Most of the difference between this and the measured volume of the flood at the downstream point of measurement represents loss of water in the main channels, most of which eventually represents the amount of aquifer recharge; and (6) The long-term annual runoff coefficient for the larger catchments is small, and may range from 1 to 2%. For the so-called 'point areas' it may reach ten times this figure. (See also W87-08661) (Lantz-PTT)
W87-08662

FLUVIAL HYDROLOGY,
New Hampshire Univ., Durham.
S. L. Dingman.
W.H. Freeman and Co., New York, NY. 1984. 383 p.

Descriptors: *Streamflow, *Open-channel flow, *Fluvial hydrology, *Channel flow, *Sediment transport, Erosion, Flow profiles, Flow resistance, Steady flow, Unsteady flow, Flow patterns, Alluvial channels.

The term fluvial hydrology was coined in order to emphasize concern with the physics of flow in the land phase of the hydrologic cycle as well as its close relation to fluvial geomorphology. Development of the subject begins at an elementary level, with a discussion of dimensions, units, significant figures, and types of equations (Chapter 2 and 3). This text is enhanced with: (1) working out solutions to problems; (2) discussion of papers from the literature, showing how principles are applied in attacking real problems; and (3) laboratory and/or field experience. In the present text, exercises have been provided at the end of each chapter (except the first). Chapters 6 through 12 cover such topics as: uniform flows in open channels; mechanical energy in open-channel flows; flow resistance, erosion, and sediment transport; gradually varied steady flows; rapidly varied steady flows; gradually varied unsteady flows; and, principles of flow through porous media. (Lantz-PTT)
W87-08685

TRACER STUDY OF VERTICAL EXCHANGE BY CUMULUS CLOUDS,
Environmental Protection Agency, Research Triangle Park, NC. Atmospheric Science Research Lab.
J. K. S. Ching, and A. J. Alkezweeny.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 11, p 1702-1711, November 1986. 6 fig, 3 tab, 24 ref. EPA Contract DE-AC06-76RLO, and Interagency agreement AGIEPA-DW930059-01-0.

Descriptors: *Convection, *Path of pollutants, *Tracers, *Clouds, *Cloud physics, *Air pollution, *Kentucky, *Acid rain, Cumulus, Entrainment.

This paper examines the exchange of material by convection cloud processes between the mixed layer and the overlying free troposphere. It describes the results of a field experiment that was conducted in Lexington, Kentucky, during the period from 20 July to 24 August 1983 to study the processes associated with vertical transport of acidic pollutants by non precipitating cumulus convection. An aircraft released SF6 tracer either within or above the mixed layer in the active cumulus convection cloud zone, as well as on the ground. The results show that mixed layer pollutants are vented above the entrainment zone of its boundary layer into the overlying cloud layer by fields of active cumulus and that such active clouds may force cloud layer air downward into the mixed layer. (Author's abstract)
W87-08699

GROUNDWATER RECHARGE AND DISCHARGE RESPONSE TO RAINFALL ON A HILLSLOPE,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
For primary bibliographic entry see Field 2F.
W87-08706

SOIL WATER BALANCE MODEL FOR SLOPING LAND,
Whatawhata Hill Country Research Station, Hamilton (New Zealand).
J. S. Bircham, and A. G. Gillingham.
New Zealand Journal of Agricultural Research NEZFA7, Vol. 29, No. 2, p 315-323, 1986. 3 fig, 4 tab, 14 ref.

Descriptors: *Rainfall-runoff relationships, *Infiltration, *Soil water, *Model studies, *Slopes, *Simulation, *Runoff, Calibrations, Evapotranspiration, Prediction, Rainfall.

Simulation models of soil water balance for flat land are not applicable to hill soils, principally because on the latter sites significant runoff can occur before the soil reaches field capacity. Part of the data from regular measurements of topsoil (0-75 mm depth) moisture content over a 3-year period on the north aspect of a steepland yellow-brown earth soil was used to construct a simulation model which described changes in soil moisture to 150 mm depth during the year. Similar data collected on a south aspect of the soil and also on north and south aspects of a yellow-brown loam hill soil were used to evaluate the model. A 4-layer model was developed in which the rate of soil rewetting was empirically limited according to soil moisture content and evapotranspiration rate was primarily soil-controlled. Predicted topsoil moisture levels provided similar, but generally lower values compared to actual levels, especially during the summer to late winter period. The greater discrepancy during early spring could be attributed to the role of unaccounted-for subsurface flow downslope and/or rapid infiltration bypassing surface layers but contributing to actual moisture levels below the soil surface. Despite these limitations the modelling exercise enabled 2 major conclusions to be drawn which were not previously apparent. First, because of the low storage capacity of these soils the availability of moisture to pasture was highly dependent on rewetting frequency rather than total rainfall and, second, as a result of this, probably less than 50% of the total annual rainfall was involved in replenishing soil moisture at plant-available depths. (Author's abstract)
W87-08735

MODELLING WATER EXCHANGE AND TRANSIT TIMES IN TILL BASINS USING OXYGEN-18,

Sveriges Meteorologiska och Hydrologiska Inst., Norrkoeping.
G. Lindstrom, and A. Rodhe.
Nordic Hydrology NOHYBB, Vol. 17, No. 4/5, p 325-334, 1986. 7 fig, 19 ref.

Descriptors: *Rainfall-runoff relationships, *Snowmelt, *Water exchange, *Model studies, *Till basins, *Isotopic tracers, *Oxygen isotopes, *Tracers, Isotopes, Model testing, Hydrologic models, Simulation.

The application of hydrological cycle models to data obtained using conservative tracers for runoff processes can yield information about transit times and storage volumes and may provide an independent test of the model structure. The PULSE-model was modified to simulate conservative tracers. Attempts were made to describe both short-term and long-term variations in oxygen-18 concentration in three small forested basins. The performance of the model was improved considerably when additional storage was introduced in the model. The turnover times were estimated to be approximately 7 and 12 months for two of the basins. (Author's abstract)
W87-08821

RUNOFF STUDIES IN A SMALL CATCHMENT,
Oslo Univ. (Norway). Inst. for Geophysics.
For primary bibliographic entry see Field 2E.
W87-08822

OPERATIONAL SPRING TIME FORECASTING DIFFICULTIES AND IMPROVEMENTS,
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 2E.
W87-08824

STEADY-STATE ANALYSIS OF INFILTRATION AND OVERLAND FLOW FOR SPATIALLY-VARIED HILLSLOPES,
Utah State Univ., Logan. Dept. of Forest Resources.
For primary bibliographic entry see Field 2E.
W87-08974

URBAN STORMWATER HYDROLOGY.
American Geophysical Union, Washington, DC.
For primary bibliographic entry see Field 4C.
W87-09096

RAINFALL FOR URBAN STORMWATER DESIGN,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W87-09098

RAINFALL ABSTRACTIONS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
G. Aron.
IN: Urban Stormwater Hydrology, American Geophysical Union, Washington, DC. Water Resources Monograph 7, 1982. p 69-86, 8 fig, 5 tab, 22 ref.

Descriptors: *Urban hydrology, *Urban runoff, *Interception, *Infiltration, *Depression storage, *Runoff rates, Mathematical models, Runoff volume, Interception loss, Storm runoff, Hydrologic models, Mathematical studies, Runoff forecasting, Evaporation, Infiltration capacity, Infiltration rate.

Rainfall abstractions or losses in the form of interception, depression storage, and infiltration are among the most important factors in the estimation of runoff rates from rainfall; yet, they are subject to the most uncertainty and are the weakest link in these estimates. Interception is that protion of the rain which is retained by leaves and stems of vegetation or other cover. Horton (1919) measured and plotted interception as a function of rainfall amount for single storms and various types of trees. Depression storage accounts for that amount of rainfall which gets trapped in small puddles without either infiltrating or running off. The Denver Regional Council of Governments compiled a table of suggested depression and detention depths for various land covers for determining depression storage. Infiltration has been expressed as a function of time, soil permeability, capillary suction, and soil storage capacity by various equations. The best-known and most widely used infiltration equation is that of Horton (1940). Other methods of estimating infiltration are the Green and Ampt equation, the Soil Conservation Service (SCS) method, and the Phi index. The Green and Ampt concept of infiltration is based on the Darcy law of flow through porous media, plus the assumption that there is a well-defined wetting front and capillary suction at a given depth, and that the degree of saturation as well as the hydraulic conductivity behind the wetting front are constant. The SCS equations is based on the soil cover complex number, for which values are listed in various tables as a function of soil classification and land use or cover. The Phi index is used as a bookkeeping method to estimate a uniform loss rate when rainfall and runoff records are available for a storm event. Studies have demonstrated that infiltration losses or roughness coefficients on pervious areas in watersheds more than 50% developed had very little effect on the magnitude of flood peaks from moderate storms. (See also W87-09096) (Geiger-PTT)
W87-09099

DESK-TOP METHODS FOR URBAN STORMWATER CALCULATION,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
D. F. Kibler.
IN: Urban Stormwater Hydrology, American Geophysical Union, Washington, DC. Water Resources Monograph 7, 1982. p 87-135, 9 fig, 19 tab, 38 ref.

Descriptors: *Hydrologic models, *Urban runoff, *Storm runoff, *Mathematical models, *Urban drainage, *Urban hydrology, Drainage systems, Hydrographs, Overland flow, Rainfall-runoff relationships, Urban watersheds, Water quality.

The philosophy and the essential steps in applying three desk-top runoff methods to a simple urban basin, the Calder Alley Drainage System, are presented. The underlying principle of the rational method is that under steady rainfall intensity, maximum discharge will occur at a basin outlet at a time when the entire area above the outlet is contributing runoff. It is essentially a peak discharge method that is usually applied to small urban basins of less than 1 sq mile in area. The Soil Conservation Service (SCS) composite hydrograph method for small urban drainage basins (TR 55) utilizes a subarea approach to represent nonuniform runoff contributions and flood-routing effects. The synthetic 10-min urban hydrograph (UH) developed by Espey and Altman (1978) is described by UH paramters as they relate to basin area, channel lenth, slope, impervious fraction and conveyance index. Outflow peaks computed by the three methods are compared to those calculated by two urban runoff models and results generated by the British Road Research Laboratory method. The SCS TR 55 method offers ease in assigning runoff curve numbers depending on soils, surface cover, and land use. The Espey synthetic UH method offers a full-hydrograph alternative to the rational and SCS TR 55 methods. It is simple to apply, but requires careful judgment in the selection of the watershed conveyance factor. The rational method has all the inherent limitations of a design storm method and is confined to use on small urban basins where rainfall intensities can be assumed highly sensitive to the time of concentraiton and the runoff coefficient. Several desk-top methods for urban runoff quality prediction are discussed. (See also W87-09096) (Geiger-PTT)
W87-09100

URBAN RUNOFF PROCESSES,
Camp, Dresser and McKee, Inc., Annandale, VA.
L. A. Roesner.
IN: Urban Stormwater Hydrology, American Geophysical Union, Washington, DC. Water Resources Monograph 7, 1982. p 137-159, 11 fig, 1 tab, 4 ref.

Descriptors: *Urban runoff, *Urban hydrology, *Storm runoff, *Urban drainage, *Storm sewers, *Mathematical models, Hydrologic models, Overland flow, Combined sewers, Urban hydrology, Subsurface drainage, Channel flow, Flow characteristics, Surface drainage, Urban watersheds, Sewer systems, Sewer hydraulics.

Typical urban drainage systems exhibit an array of subsystems which interact to convey rainfall from its point of impact to the receiving waters. The subsystem is characterized by three basic sectors: surface runoff, transport through sewers and major drainage facilities, and receiving water. Hydrologic input to the surface runoff subsystem is composed of a rainfall hyetograph derived from direct measurements in the watershed. The overland flow process transforms the rainfall-excess hyetograph so that at the inlet an inlet hydrograph is observed. The transport subsystem is composed of the physical works for conveying storm water and their associated pollutant loads from all of the inlets in the system through a network of storm channels and/or underground conduits to a point (or points) of disposal. The receiving water subsystem may be of several forms: stream, lake estuary, or coastal. In many older cities in the United States the storm drainage system and the sanitary wastewater system flow in the same pipes of a combined sewer system. The conceptual approach and basic mathematical formulations that are used in the U. S. Environmental Protection Agency (1977) stormwater management model (SWMM) to simulate urban runoff processes are described. (See also W87-09096) (Geiger-PTT)
W87-09101

SIMULATION OF THE HYDROLOGIC CYCLE FOR WATERSHEDS,
Oak Ridge National Lab., TN.
D. M. Hetrick.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as DE84-014078. Price codes: A02 in paper copy, A01 in microfiche. DOE Report No. CONF-8406175--1, (1984). 15 p, 1 fig, 4 tab, 14 ref. DOE Contract No. DE-AC05-84OR21400.

Descriptors: *Soil water, *Hydrologic models, *Evapotranspiration, *Forest watersheds, *Hydrologic cycle, *Mathematical studies, Vegetation, Infiltration, Soil moisture retention, Surface runoff, Groundwater runoff, Algorithms, Soil-water-plant relationships, Agricultural watersheds.

The SESOIL and AGTEHM soil hydrology models have been used to compute hydrologic cycle components for two watersheds. SESOIL is a statistical and seasonal model with respect to the hydrologic cycle, and is viewed as a screening-level model that is used for long term environmental simulations. The terrestrial ecosystem hydrology model AGTEHM combines mechanistic algorithms for climatic and hydrologic processes with vegetation properties to simulate water flow components every hour, except during rainy periods when 15 minute time steps are used. Monthly comparisons are made between the relatively simple SESOIL model and the complex AGTEHM model using data from a forest stand watershed and an experimental agricultural field plot. Good agreement was obtained between annual model predictions for soil moisture, infiltration, evapotranspiration, surface runoff, and groundwater runoff. SESOIL model predictions are also compared directly with observations at the forest stand watershed. (Author's abstract)
W87-09111

PHYSICAL CHANGES INDUCED BY RAINFALL IN THE SURFACE LAYER OF AN ALFISOL, NORTHERN NIGERIA,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Soil Science.
For primary bibliographic entry see Field 2G.
W87-09214

PRINCIPLES OF AQUATIC CHEMISTRY,
Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
For primary bibliographic entry see Field 2K.
W87-09305

AQUATIC CHEMISTRY: AN INTRODUCTION EMPHASIZING CHEMICAL EQUILIBRIA IN NATURAL WATERS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
W. Stumm, and J. J. Morgan.
John Wiley and Sons, New York, NY. 1981. 780 p.

Descriptors: *Aquatic environment, *Chemical properties, *Equilibria, Ecology, Water pollution, Water quality control, Chemical analysis, Seawater, Isotopes, Physical properties, Kinetics, Chemical reactions.

A quantitative treatment of the variables that determine the composition of natural waters is provided by drawing upon basic chemical principles. Chemical equilibrium continues to be the central theme in treatment, but steady-state and dynamic models using mass-balance approaches and kinetic information have been given more attention. This book is written for those who share a concern and sense of responsibility for the environment. Because humankind has become a more powerful participant in the biosphere, a chapter giving a chemical and ecological perspective on pollution and its control is included. The author attempts to show how pollution affects water quality and how the aquatic ecosystem responds to human impact, especially to stress caused by chemical perturbation. The distribution of pollutants in air, water, and soil is discussed and the environmental movement assessed. It is clear that pollution is no longer a local of regional problem, but that people can influence and change global chemical cycles of the environment. Chapter 8 introduces the subject of organic carbon compounds in natural water systems. There is a detailed consideration of seawater chemistry, including activity conventions in seawater (Chapters 4 and 6). The treatment of the solid-solution interface (Chapter 10) reflects significant advances in concepts and experimental developments during the past decade. Inclusion of material on stable and radioactive isotopes (Chapters 4 and 5) illustrates their value in characterizing physical and chemical processes in natural water systems. The emphasis on kinetics in a number of chapters (Chapter 2,4,5,7,9,10,11) shows the interplay between kinetic considerations and equilibria. The consideration of metal-ligand interactions in Chapter 6 includes ion pairs and complexes, inorganic speciation, complexing by organics, alkylation and multicomponent, multispecies models. (Lantz-PTT)
W87-09340

2B. Precipitation

INTERCEPTION LOSSES OF RAINFALL FROM CASHEW TREES,
Centre for Water Resources Development and Management, Calicut (India). Water Management (Ag) Division.
For primary bibliographic entry see Field 2I.
W87-08621

IMPACT OF MESOSCALE CONVECTIVE SYSTEMS ON REGIONAL VISIBILITY AND OXIDANT DISTRIBUTIONS DURING PERSISTENT ELEVATED POLLUTION EPISODES,
W. A. Lyons, R. H. Calby, and C. S. Keen.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 11, p 1518-1531, November 1986. 12 fig, 2 tab, 33 ref. EPA Contract 68-02-3740.

Descriptors: *Path of pollutants, *Mesoscale systems, *Precipitation, *Air pollution, *Air pollution effects, *Convective precipitation, Spatial variation, Oxidants, Distribution, Transport.

It is generally accepted that atmospheric pollutants can be transported over distance described as synoptic in scale. However, the redistribution and removal of the various pollutant species may be significantly influenced, often in a highly episodic way, by phenomena which are inherently mesoscale in nature. Detailed mesoanalysis over a 31 hour period reveal the dramatic influence of several types of mesoscale convective systems on regional ozone and visibility. In the impacted airmass, afternoon ozone was significantly depleted (20-40 ppb vs 100-120 ppb in the polluted regional air mass). Visibilities which prior to the wind shift/rain had typically been 4 -13 km rose in a matter of a few hours to 27 -80 km at many locations. This convective aerosol removal event covered Virginia, North Carolina, Delmarva, and more than 500 km into the Atlantic, as clearly evidenced by GOES satellite imagery. Assuming a relationship between visibility and sulfate aerosol mass concentrations, it is speculated that approximately 30 times 10 to the 6 power kg of sulfate were removed from the planetary boundary layer (PBL). The removal was not solely due to wet deposition. Rather, consideration of thunderstorm dynamics suggest that perhaps two thirds of the removal of PBL could have been due to convective displacement into the free atmosphere, perhaps to altitudes as high as the tropopause. (Author's abstract)
W87-08695

NUMERICAL SIMULATION OF THE EFFECTS OF VARYING ICE CRYSTAL NUCLEATION RATES AND AGGREGATION PROCESSES ON OROGRAPHIC SNOWFALL,
Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
W. R. Cotton, G. J. Tripoli, R. M. Rauber, and E. A. Mulvihill.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 11, p 1658-1680, November 1986. 15 fig, 44 ref, append. Air Force Geophysics Laboratory Contract F19628-84-C-0005, NSF Grants ATM-8312077, ATM-8512480 and ATM-8407543.

Descriptors: *Model studies, *Snowfall, *Clouds, *Numerical analysis, *Nucleation, *Orographic precipitation, *Ice crystals, *Mathematical models, Mathematical studies, Atmospheric physics.

The Colorado State University cloud model is applied to the simulation of orographic cloud snowfall. A model of ice crystal aggregation processes and primary nucleation and secondary ice particle production of crystals is described. Sensitivity experiments demonstrated that aggregation plays an important role in controlling the fields of cloud liquid water content, ice crystal concentrations, and surface precipitation amounts. The sensitivity experiments also support observations that the air mass is often quite clean in upper levels of stable orographic clouds. Introducing a reduction of available nuclei that can be activated by deposition/sorption process brought concentrations to within observed values. This study clearly emphasizes the need for a great deal more fundamental research in the physics of aggregation processes and primary and secondary nucleation of ice crystals. (Author's abstract)
W87-08697

RAINFALL KINETIC ENERGY IN EASTERN AUSTRALIA,
Soil Conservation Service, Gunnedah (Australia).
C. J. Rosewell.
Journal of Climate and Applied Meteorology JCAMEJ, Vol.l 25, No. 11, p 1695-1701, November 1986. 6 fig, 3 tab, 24 ref.

Descriptors: *Soil erosion, *Rainfall, *Kinetic energy, *Rainfall intensity, *Eastern Australia, Distrometers.

Rainfall kinetic energy is a commonly used climatic parameter for the prediction of soil erosion by water. Such a parameter is difficult to measure and is usually estimated from relationships established between rainfall energy and rainfall intensity. Previous studies have shown a variation in energy intensity relationships throughout the world. This paper reports the results of measurements of rainfall intensity and rainfall energy using distrometers at four widely separated locations in eastern Australia. These data demonstrate little geographic variation and support the conclusion that the energy of rain is substantially constant at intensities exceeding 100 mm per hour. (Author's abstract)
W87-08698

RELATIVE ACCURACY OF SATELLITE AND RAINGAGE RAINFALL MEASUREMENTS OVER MIDDLE LATITUDES DURING DAYLIGHT HOURS,
McGill Radar Weather Observatory, Ste. Ann de Bellevue (Quebec).
A. Bellon, and G. L. Austin.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 11, p 1712-1724, November 1986. 7 fig, 2 tab, 25 ref.

Descriptors: *Rainfall intensity, *Measuring instruments, *Radar, *Rain gages, *Satellite technology, *Remote sensing, *Statistical analysis, Montreal.

Empirical Relationships between visible and/or IR data are derived by comparing gage calibrated radar data with colocated satellite information over Montreal, Canada. The accuracy of 1739 point gage-satellite measurements from 14 sequences of summertime rainfall during daylight hours is evaluated. The absolute difference is 85 percent and is defined as the sum of the absolute value of G sub i minus S sub i divided by the sum of G sub i, where G sub i and S sub i are the corresponding gage and satellite estimates. The Critical Success Index (CSI), the Probability of Detection (POD), and the False Alarm Ration (FAR) at the 2 mm level are of the order of 50, 70, and 35 percent, respectively, and the cross-correlation coefficient (Gamma) is computed to be 0.56. The relative accuracy in the rainfall estimation of four empirical methods based on point satellite readings is determined. The scores of the visible-IR and visible only methods are adequate (gamma = 0.56 and 0.50, respectively), but the scores of the IR only method are judged inadequate (gamma = 0.30) because of its serious overestimation. A rain/no-rain estimates scores nearly as high (gamma = 0.50) as a continuous rain estimate. It is found that satellite estimates using our objective techniques are better than gage-interpolated estimates at locations where the nearest gage is farther than 40 km. The usefulness of these statistical satellite rainfall measurements is thus limited to the data sparse regions of the world. (Author's abstract)
W87-08700

EXPERIMENTAL MONTHLY LONG LANGE FORECASTS FOR THE UNITED KINGDOM: PART III. SKILL OF THE MONTHLY FORECASTS.
Meteorological Magazine MTMGA5, Vol. 115, No. 1373, p 377-395, December 1986. 6 fig, 6 tab, 17 ref, 2 append.

Descriptors: *Weather forecasting, *Long range forecasting, *Statistical methods, Temperature, Rainfall.

Evidence is shown for recent fairly sudden, though modest improvement of skill of monthly forecasts, especially those of temperature extremes and rainfall. These forecasts are derived from forecast patterns of pressure at mean sea level (PMSL) made for three periods within the month. A first analysis is given of the skill of the derived monthly mean PMSL forecasts (for July 1982 to July 1986) and preliminary analyses of the recent skill of the temperature and the rainfall forecasts for several distinct periods within the month ahead, including the second half-month, to help indicate whether the forecasts have skill on the purely 'long-range' timescale. The skill of the monthly long-range forecasts varied within the ten United Kingdom districts studied and also from season to season. Forecasts for summer and winter have contributed more to recent increases in skill, especially forecasts of temperature in winter and rainfall in summer. Forecasts in spring have been less successful. There was marked overall tendency for the skill averaged over a longer forecast period to be larger than its weighted average over constituent

shorter periods. This tendency may result from timing errors in the forecasts which reduce skill more strongly on shorter time scales than on longer ones. (Ram-PTT)
W87-08701

SNOW FORECASTS FROM THE METEORLOGICAL OFFICE FINE-MESH MODEL DURING THE WINTER OF 1985/86,
Meteorological Office, Bracknell (England).
T. Davies, and O. Hammon.
The Meteorological Magazine MTMGA5, Vol. 115, No. 1373, p 396-404, December 1986. 7 fig, 3 tab, 6 ref.

Descriptors: *Meteorology, *Model studies, *Snow, *Weather forecasting, *England, Prediction, Comparison studies, Performance evaluation.

The performance of the Meteorological Office fine-mesh model in forecasting snow during the winter of 1985/86 is examined. The fine-mesh model is a grid-point model with a grid length over the United Kingdom of about 75km. As a result of approximations used in the modelling process, accurate detail cannot be achieved on a scale below one or two grid lengths, about 100km. The snow predictor currently used in the model, 1000-850 mb predictor, is compared with other possible predictors to see whether an alternative predictor could provide more precise guidance. It is found that much of the success of the 1000-850 mb predictor depends upon the experience of the user. (Ram-PTT)
W87-08702

GROUNDWATER RECHARGE AND DISCHARGE RESPONSE TO RAINFALL ON A HILLSLOPE,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
For primary bibliographic entry see Field 2F.
W87-08706

SOME METALS AND THEIR POSSIBLE SOURCES IN RAIN WATER OF THE SOUTHERN BALTIC COAST, 1976 AND 1978-1980,
Medical Academy, Gdansk (Poland). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5B.
W87-08726

RAINFALL IN THE WET-DRY TROPICS: EXTREME EVENTS AT DARWIN AND SIMILARITIES BETWEEN YEARS DURING THE PERIOD 1870-1983 INCLUSIVE,
Commonwealth Scientific and Industrial Research Organization, Winnellie (Australia). Div. of Wildlife and Rangelands Research.
J. A. Taylor, and D. Tulloch.
Australian Journal of Ecology AJECDQ, Vol. 10, No. 3, p 281-295, September 1985. 1 fig, 6 tab, 71 ref, append.

Descriptors: *Data collections, *Meteorological data collection, *Climates, *Rainfall, *Tropical areas, *Darwin, Temporal variation, Seasonal variation, Surveys, Monitoring, Field tests.

This paper supplements the existing climatic analyses for Darwin and the surrounding region, by providing a classification of years in terms of amount and distribution rainfall, and highlighting the extreme, episodic rainfall events that have occurred in the period 1870 to 1983 inclusive. Approximately 77% of years have had significant departures from the two most frequent rainfall patterns and these are described. Much of the variation between years or groups of years lies in the dry and dry-wet transition periods. While the reliability of rainfall in the wet-dry tropics has been emphasized, rainfall variability over both the dry and wet seasons would seem to be an equally important characteristic, at least for the biota. In an environment such as the wet-dry tropics, where moisture is the primary limiting factor, rainfall variability has important implications for the design and interpretation of faunal and floristic surveys, monitoring programs and field experiments. (Author's abstract)
W87-08775

IMPACT OF SIMULATED ACIDIC PRECIPITATION ON QUANTITY AND QUALITY OF A FIELD GROWN POTATO CROP,
Pennsylvania State Univ., University Park. Dept. of Plant Pathology.
For primary bibliographic entry see Field 5C.
W87-08789

RAINFALL PATTERN ASSOCIATED WITH A SPLIT COLD FRONT AS SEEN ON FRONTIERS,
Meteorological Office, Bracknell (England).
K. A. Browning.
Meteorological Magazine MTMGA5, Vol. 116, No. 1347, p 21-23, January 1987. 2 fig, 2 ref.

Descriptors: *Data interpretation, *Rainfall distribution, *Rainfall, *Cold fronts, *FRONTIERS, Rainfall area, British Isles, Precipitation, Orographic precipitation, Weather patterns, Satellite technology, Radar.

The radar rainfall pattern associated with a split cold front is used to illustrate the way in which the FRONTIERS (Forecasting Rain Optimized using New Techniques of Interactively Enhanced Radar and Satellite) display can be used to understand subsynoptic weather systems. The position and description of a cold front and related precipitation located by a FRONTIERS operator in November 1986 in the British Isles was detailed. An advantage of the FRONTIERS display system is that it enables the operator to compare, replay and otherwise manipulate radar and satellite imagery so that subsynoptic weather systems can be understood rapidly. (Wood-PTT)
W87-08800

LONGER-DURATION POST-FRONTAL PRECIPITATION AT VANCOUVER INTERNATIONAL AIRPORT, 1953-1983,
W. S. Pike.
Weather WTHRAL, Vol. 42, No. 2, p 34-41, February 1987. 2 fig, 1 tab, 8 ref.

Descriptors: *Precipitation, *Rainfall, *Post-frontal precipitation, *Precipitation excess, *Vancouver, *Rainfall duration, Weather, Excess rainfall, British Columbia, Rainfall disposition, Seasonal variation.

Long-duration post-frontal precipitation was experienced in Vancouver, British Columbia, during 1980. Data from the Vancouver International Airport was checked using Bracknell's circumpolar charts to determine which synoptic situations were responsible for the long-duration post-frontal precipitation which was defined as continuous or mostly-continuous precipitation exceeding four hours in duration. The effects of the mountain barriers north-north-east of the City, the surface features, and 500 mbar flow were discussed. It was found that there was a marked seasonal variation in the frequency of post-frontal precipitation events, with a maximum in late spring. The three longest durations occurred in May, with a November/December secondary maximum, indicating how events tended to occur in association with the change in seasons. (Wood-PTT)
W87-08809

CORRECTION OF LIQUID PRECIPITATION,
Danish Meteorological Inst., Copenhagen.
P. Allerup, and H. Madsen.
Nordic Hydrology NOHYBB, Vol. 17, No. 4/5, p 237-250, 1986. 9 fig, 3 tab, 14 ref.

Descriptors: *Precipitation, *Statistical models, *Rainfall, *Wind velocity, *Data processing, *Model studies, Mathematical studies, Mathematical equations, Mathematical models, Errors, Error correction, Error analysis, Model testing, Wetting, Precipitation intensity, Rainfall intensity.

A bi-linear statistical model for correcting aerodynamic errors which was presented by the authors in 1980 was discussed. Further data from Finland, USA and Australia testing the model were presented. A simplification extended the applicability of the correction model when implemented into automatic correction systems. The problems of fit by the simplified model were discussed and attention was given to physical interpretation of the mathematical structure in the model. Besides aerodynamic errors, wetting losses influence the correction values. It was demonstrated that these effects cause corrections that are too large for small amounts of precipitation and that are too small for large amounts of precipitation. (Author's abstract)
W87-08813

ESTIMATION OF CANOPY RESERVOIR CAPACITY AND OXYGEN-18 FRACTIONATION IN THROUGHFALL IN A PINE FOREST,
Uppsala Univ. (Sweden). Div. of Hydrology.
R. K. Saxena.
Nordic Hydrology NOHYBB, Vol. 17, No. 4/5, p 251-260, 1986. 3 fig, 1 tab, 8 ref.

Descriptors: *Canopy, *Model studies, *Throughfall, *Rainfall, *Precipitation, *Isotope fractionation, *Forest hydrology, *Coniferous forests, *Trees, Conifers, Canopy reservoir capacity, Isotope studies, Oxygen Isotopes, Oxygen, Simulation, Simulated rainfall, Mathematical equations, Mathematical studies, Uppsala, Sweden, Monitoring.

Amount and oxygen-18 content of rainfall and throughfall were monitored in a pine forest in Uppsala during the summer of 1983. It is found that the free throughfall coefficient, C, the canopy reservoir capacity, S, and the critical value of rain, R sub 0, are approximately 0.5, 2.1, and 4.1 millimeters, respectively. The average value of throughfall is about 60% of rainfall. Generally, the throughfall is enriched in oxygen-18 with respect to rainfall, but in very few cases depletion was observed. The enrichment or depletion in throughfall was predicted graphically and agreed fairly well with the observations. Oxygen-18 values of throughfall were simulated by a model describing isotopic fractionation in throughfall. It is felt that more accurate estimates of C, S, and fractionation in throughfall can be obtained by monitoring rain and throughfall in small fractions of about 0.2 millimeters or even less. (Author's abstract)
W87-08814

WATER VAPOR TRANSPORT OVER THE INDIAN OCEAN DURING THE 1979 SUMMER MONSOON. PART I: WATER VAPOR FLUXES,
Florida State Univ., Tallahassee. Dept. of Meteorology.
D. L. Cadet, and S. Greco.
Monthly Weather Review MRWEAB, Vol. 115, No. 3, p 653-663, March 1987. 14 fig, 1 tab, 25 ref.
NOAA Grant NA83AA-D-00053.

Descriptors: *Water vapor, *Monsoons, *Indian Ocean, *Winds, *Seasonal variation, *Meteorology, Rainfall, Weather, Fronts.

Water vapor transport over the Indian Ocean during the 1979 summer monsoon season is studied. The analysis is based on wind fields from the European Centre for Medium Range Weather Forecasts and humidity fields derived from a three-layer precipitable water dataset. Fields of zonal and meridional water vapor fluxes show significant variations over the north Indian Ocean in association with the different phases of the 1979 monsoon. Whereas after the onset, the cross-equatorial water vapor flux west of 50 deg E does not vary much; it undergoes significant fluctuations east of that longitude. The bulk of water vapor crossing the western coast of India comes from the Southern Hemisphere. The latitude band between 10 and 20 deg S appears as a major source of moisture during the northern summer. The major moisture supply for the western coast of Burma and Thailand is advected over the Bay from the Arabian Sea branch of the monsoon. The water vapor flux across the west coast of India undergoes large amplitude variations in relation with the active/break cycle of the 1979 monsoon (onset, active, break and revival periods). During active periods, the moist flow

over the Arabian Sea strengthens and deepens. The water vapor flux across the west coast of India is well related to rainfall along the coast. The early retreat of the 1979 monsoon is associated with a decreasing trend in moisture transport over the Arabian Sea. In the Bay of Bengal, the cross-equatorial flux is not affected by the break/active cycle of the monsoon. There are strong surges of northward flux into the Bay. Some of them are related to the formation of Bay depressions. (Author's abstract)
W87-08937

CONSISTENT PARAMETERIZATION OF THE EFFECTS OF CUMULUS CLOUDS ON THE LARGE-SCALE MOMENTUM AND VORTICITY FIELDS,
Oregon State Univ., Corvallis. Dept. of Atmospheric Sciences.
S. K. Esbensen, L. J. Shapiro, and E. I. Tollerud.
Monthly Weather Review MRWEAB, Vol. 115, No. 3, p 664-669, March 1987. 12 ref. NSF Grant ATM-8414820; NOAA Assignment agreement NA-85-WC-P-06125.

Descriptors: *Cumulus clouds, *Convection, *Vorticity fields, *Meteorology, *Model studies, Clouds, Weather, Detrainment, Parameterization.

A physical and mathematical framework for the mutually consistent parameterization of the effects of cumulus convection on the large-scale momentum and vorticity fields is proposed. The key to achieving consistency is the understanding that the vorticity dynamics of the clouds below the spatial resolution of a large-scale dynamical model may be neglected in the vorticity budget when the clouds are considered to be independent buoyant elements sharing a common large-scale environment. This simplified approach is used to obtain a consistent pair of large-scale momentum and vorticity equations based on Ooyama's theory of cumulus parameterization. The results focus attention on the need to obtain a better understanding of the detrainment process and the pressure interactions between the clouds and their environment. (Author's abstract)
W87-08938

TROPICAL SQUALL LINE OBSERVED DURING THE COPT 81 EXPERIMENT IN WEST AFRICA. PART I: KINEMATIC STRUCTURE INFERRED FROM DUAL-DOPPLER RADAR DATA,
Centre de Recherche en Physique de l'Environnement Terrestre et Planetaire, Issy-les-Moulineaux (France).
M. Chong, P. Amayenc, G. Scialom, and J. Testud.
Monthly Weather Review MRWEAB, Vol. 115, No. 3, p 670-694, March 1987. 20 fig, 39 ref.

Descriptors: *Meteorology, *Measuring instruments, *Radar, *Clouds, *Convection, *Air currents, Updraft, Downdraft.

This paper is restricted to the study of the kinematic structure of the system, which moved in a moderately unstable atmosphere, faster than the environmental air at all levels. The explicit description of the airflow within the system was inferred from dual- and single-Doppler radar data. A large cloud system composed of an organized convective line ahead of an extensive trailing anvil cloud (stratiform rain), fast motion and long-lasting structure and a well-marked gust front signature at ground level. The overall airflow presents a three-dimensional structure. At the leading edge, convective-scale updrafts are fed by converging warm boundary layer air which is subsequently transferred rearward into the trailing anvil. Convective-scale downdrafts fed by midtropospheric air participate in the formation of a cold rear-to-front flow normal to the squall line. This flow strongly opposes the front-to-rear flow associated with warm air. A mesoscale updraft within the trailing anvil cloud and mesoscale downdraft below the anvil cloud are fed by midtropospheric convergence. However, detailed aspects of the three-dimensional wind field reveal significant differences. The rear-to-front flow is observed in a deep layer 3 km thick. From mass transport estimation, it is found that convective and mesoscale downdrafts accounted for 40 and 60% of the deep rear-to-front flow, respectively. Through this mechanism, the mesoscale downdraft plays an important role in the generation of convective updrafts along the leading gust front. In fact, part of the mesoscale downdraft air spreads forward and overlies the outflow generated in the surface layer by the convective-scale downdrafts. This results from processes occurring in the trailing anvil. Indeed, relatively large mesoscale updraft and downdraft characterize this trailing part of the system which exhibits two regions of differentiated kinematic structure: the reflectivity trough (associated with weak precipitation) immediately behind the convective region, and the trailing stratiform region. The mesoscale downdraft in the reflectivity trough is observed in a deep layer from the surface to about 6 km altitude, while it occurs below the anvil-base level (4 km) in the stratiform region. (Author's abstract)
W87-08939

EMPIRICAL PREDICTION OF THE SUMMER MONSOON RAINFALL OVER INDIA,
Maryland Univ., College Park. Dept. of Meteorology.
J. Shukla, and D. A. Mooley.
Monthly Weather Review MRWEAB, Vol. 115, No. 3, p 695-703, March 1987. 4 fig, 3 tab, 22 ref. NSF Grant ATM-8414660; NASA-NAGW-558.

Descriptors: *Weather forecasting, *Regression analysis, *Data interpretation, *Monsoons, *India, *Meteorology, Weather data collections, Rainfall, Prediction.

Synoptic and statistical relationships between the summer monsoon rainfall over India, the Southern Oscillation, and the midtropospheric circulation over India were studied using 46 years of observed data. The change in Darwin pressure from January to April and the latitudinal position of the April 500-mb ridge along 75 deg E are taken as two quasi-independent predictor parameters to develop a regression equation to predict the summer monsoon rainfall. Verification of predictions on independent data shows that the root-mean-square error for predicted rainfall is 36 mm, which is less than half of the standard deviation (82 mm) and only about 4% of the mean rainfall (857 mm). Since the observations needed to define the predictor parameters would be available well before the monsoon season, and since the performance of the empirical prediction formula is reasonably good, this method can be of some possible use for long-range forecasting of seasonal mean rainfall over India. (Author's abstract)
W87-08940

RELATIONSHIP OF LOW-LEVEL WINDS AND MOISTURE TO CONVECTION IN THE TROPICAL PACIFIC,
Cooperative Inst. for Research in Environmental Science, Boulder, CO.
E. J. Steiner.
Monthly Weather Review MRWEAB, Vol. 115, No. 3, p 744-749, March 1987. 5 fig, 1 tab, 24 ref.

Descriptors: *Convection, *Winds, *Humidity, *Pacific Ocean, *Regression analysis, El Nino, Rainfall, Weather, Meteorology.

Strong convection in the tropical Pacific is found to be enhanced when low-level winds are westerly and poleward directed. This means that winds which blow opposite to the normal easterly, equatorward trade-wind flow are associated with strong convection. Linear regression demonstrates that about 30-40% of the variance in convection across the Pacific during the 1982-83 El Nino can be explained by low-level precipitable water plus the low-level winds. (Author's abstract)
W87-08941

ANALYSIS OF THE IMPACT OF THE SUDBURY SMELTERS ON WET AND DRY DEPOSITION IN ONTARIO,
Ontario Ministry of the Environment, Toronto. Air Resources Branch.
For primary bibliographic entry see Field 5B.
W87-08942

RAINFALL ACIDITY AS RELATED TO METEOROLOGICAL PARAMETERS IN NORTHERN QUEBEC,
Montreal Univ. (Quebec). Dept. of Geography.
B. Singh, M. Nobert, and P. Zwack.
Atmospheric Environment ATENBP, Vol. 21, No. 4, p 825-842, April 1987. 3 fig, 8 tab, 34 ref.

Descriptors: *Acid rain, *Rainfall, *Meteorology, *Quebec, *Hydrogen ion concentration, Ions, Winds, Weather, Precipitation.

Summer-time rainfalls during 1980 and 1981 were collected at several sites near La Grande, 200 km inland from the James Bay coast, in Northern Quebec. These were analyzed for pH and the concentrations of major ions. Concurrent and prior measurements were also taken or derived for a series of meteorological parameters including 85 Kp level wind speed and direction, 85 Kp level air temperature, vertical air movement, these during and prior to rainfall, precipitation amount, duration and intensity, prior duration of precipitation, precipitation type, boundary layer height, surface pressure and surface pressure change and atmospheric divergence. Results demonstrate that wind speed at 85 Kp level 48-72 h prior to rainfall, wind direction at 85 Kp 72 h prior, air temperature at 85 Kp during rainfall and 60-72 h prior, vertical movement of the atmosphere 24 h prior, boundary layer height, surface pressure and surface pressure change and rainfall amount and duration at the site as well as prior duration of rainfall consistently correlate with the log of major ions in rainfall. Also surface wind direction, precipitation type and the trajectory of air masses do not consistently relate to the pH of rainfall. (Author's abstract)
W87-08943

15N/14N RATIOS OF NITRATE AND AMMONIUM IN RAIN AT PRETORIA, SOUTH AFRICA,
National Physical Research Lab. (South Africa). Natural Isotopes Div.
T. H. E. Heaton.
Atmospheric Environment ATENBP, Vol. 21, No. 4, p 843-852, April 1987. 8 fig, 5 tab, 21 ref.

Descriptors: *Isotope studies, *Nitrates, *Ammonium, *Rainfall, *Acid rain, *Nitrogen isotopes, *Pretoria, Meteorology, Weather, Precipitation, Deposition, Seasonal variation.

Data are presented for the concentrations and 15N/14N ratios of nitrate and ammonium in rain at Pretoria, South Africa, together with data for dry deposition and gases. They are discussed in terms of the influence of reaction mechanisms on isotopic fractionation and the isotopic identity of the nitrate- and ammonium-forming precursors. The data are consistent with most of the ions in rain being derived by solution of gaseous precursors, with the ammonium solution being controlled by exchange rather than uni-directional reactions. Short-term inter- and intra-storm variations in rain 15N/14N ratios are at least partly due to the effects of isotopic fractionation, with the ratios being sensitive to the amount of rain which had fallen in the preceding few days. Seasonal variations in the 15N/14N ratios of rain nitrate may reflect variations in the chemical pathways of nitrate formation and/or variations in the ratios of 'natural'/'pollution' surface emissions of NOx. There was no evidence for lightning having an effect on the formation of nitrate or ammonium in thunderstorms. (Author's abstract)
W87-08944

TWO NEW GROUND-LEVEL CLOUD WATER SAMPLER DESIGNS WHICH REDUCE RAIN CONTAMINATION,
Appalachian Mountain Club, Gorham, NH. Research Dept.
For primary bibliographic entry see Field 7B.
W87-08948

THEORY AND PRACTICE IN THE ELECTROMETRIC DETERMINATION OF PH IN PRECIPITATION,
Illinois State Water Survey Div., Champaign. Analytical Chemistry Lab Unit.
For primary bibliographic entry see Field 7B.
W87-08949

SO2 OXIDATION IN CLOUD DROPS CONTAINING NACL OR SEA SALT AS CONDENSATION NUCLEI,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 6E.
W87-08950

RADAR RAINFALL DATA QUALITY CONTROL BY THE INFLUENCE FUNCTION METHOD,
National Weather Service, Silver Spring, MD. Hydrologic Research Lab.
For primary bibliographic entry see Field 7C.
W87-09022

MARKOV RENEWAL MODEL FOR RAINFALL OCCURRENCES,
Iowa State Univ., Ames. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W87-09025

STATISTICAL MODELING OF DAILY RAINFALL OCCURRENCES,
Interstate Commission on the Potomac River Basin, Rockville, MD.
For primary bibliographic entry see Field 7C.
W87-09026

RAINFALL FOR URBAN STORMWATER DESIGN,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
H. G. Wenzel.
IN: Urban Stormwater Hydrology, American Geophysical Union, Washington, DC. Water Resources Monograph 7, 1982. p 35-67, 6 fig, 11 tab, 27 ref.

Descriptors: *Depth-area-duration analysis, *Runoff forecasting, *Simulated rainfall, *Hydrologic models, *Storm runoff, *Urban hydrology, Simulation analysis, Urban drainage, Rainfall-runoff relationships, Rainfall intensity, Hyetographs, Rainfall distribution, Mathematical models.

A design rainfall is a rainfall event, either historical or artificial, which is used as a basis for determining the design for a proposed drainage or water-related system. The most common type of design rainfall is an artificial event, termed a design storm which is based on depth-duration frequency analysis of historical data. A design rainfall is uniquely described by its frequency or return period, total depth, duration, and time distribution of depth or intensity (hyetograph). The development of design rainfall requires detailed rainfall data, sometimes in time increments as short as 5 min. A useful method of presenting rainfall data for design purposes is in the form or relationships between the average depth or intensity of rainfall for various durations and return periods or frequencies. The National Weather Service publishes depth-duration frequency data on a national basis. Methods for conducting a site-specific depth-duration-frequency analysis are described. Five methods of developing a design rainfall based on depth-duration-frequency data are described. Results are compared graphically for the Huff distribution, the Keifer and Chu distribution, the Pilgrim and Cordery method, the Yen and Chow method, and the Composite method. The advantages and disadvantages of design rainfalls are discussed along with current design rainfall research. Alternatives to design rainfall simulation include continuous simulation, modified continuous simulation, historic storms coupled with models, and improved design storm models. Design rainfalls still have little utility in designing detention storage structures or in predicting urban stormwater quality. (See also W87-09096) (Geiger-PTT)
W87-09098

DATA COLLECTION AND INSTRUMENTATION,
Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
For primary bibliographic entry see Field 7B.
W87-09103

REPORT OF THE ACID RAIN PEER REVIEW PANEL.
For primary bibliographic entry see Field 5B.
W87-09107

AMERICAN WEST'S ACID RAIN TEST,
California Univ., Berkeley. Energy and Resources Group.
For primary bibliographic entry see Field 5B.
W87-09160

MODELING OF ATMOSPHERIC WET DEPOSITION,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W87-09165

MODELING OF ATMOSPHERIC PARTICULATE DEPOSITION TO NATURAL WATERS,
Joint Center for Graduate Study, Richland, WA.
For primary bibliographic entry see Field 5B.
W87-09166

INPUT OF BIOLOGICALLY AVAILABLE PHOSPHORUS BY PRECIPITATION TO PRECAMBRIAN LAKES,
Ontario Ministry of the Environment, Rexdale. Limnology and Taxonomy Section.
For primary bibliographic entry see Field 5B.
W87-09174

ATMOSPHERIC DEPOSITION OF ACIDITY AND SULFUR IN FLORIDA,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5B.
W87-09177

TRACE METAL AND STRONG ACID COMPOSITION OF RAIN AND SNOW IN NORTHERN MINNESOTA,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
For primary bibliographic entry see Field 5B.
W87-09178

LICHENS AS MONITORS OF ATMOSPHERIC DEPOSITION,
Laurentian Univ., Sudbury (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W87-09181

ATMOSPHERIC CONCENTRATIONS AND DEPOSITION OF POLYCHLORINATED BIPHENYLS TO LAKE SUPERIOR,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
For primary bibliographic entry see Field 5B.
W87-09185

INPUTS OF POLYCHLORINATED BIPHENYLS FROM THE ATMOSPHERE TO LAKES HURON AND MICHIGAN,
De Paul Univ., Chicago, IL.
For primary bibliographic entry see Field 5B.
W87-09186

ATMOSPHERIC DEPOSITION OF PARTICULATE ORGANIC CARBON AND POLYAROMATIC HYDROCARBONS TO LAKE MICHIGAN,
Wisconsin Univ.-Madison. Water Chemistry Lab.
For primary bibliographic entry see Field 5B.
W87-09187

AERIAL DEPOSITION OF ORGANOCHLORINES IN URBAN AND COASTAL SOUTH CAROLINA,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
For primary bibliographic entry see Field 5B.
W87-09188

PESTICIDES IN FOG,
Dept. of Agriculture, Beltsville, MD. Soil Nitrogen and Environmental Chemistry Lab.
For primary bibliographic entry see Field 5B.
W87-09229

INFLUENCE OF SIMULATED ACIDIC RAIN ON VEGETATIVE AND REPRODUCTIVE TISSUES OF CUCUMBER (CUCUMIS SATIVUS L.),
Boyce Thompson Inst. for Plant Research, Ithaca, NY.
For primary bibliographic entry see Field 5C.
W87-09232

CANADIAN ATLANTIC STORMS PROGRAM: THE METEOROLOGICAL FIELD PROJECT,
Atmospheric Environment Service, Downsview (Ontario).
R. E. Stewart, R. W. Shaw, and G. A. Isaac.
Bulletin of the American Meteorological Society BAMIAT, Vol. 68, No. 4, p 338-345, April 1987. 10 fig, 5 tab, 12 ref.

Descriptors: *Meteorology, *CASP, *Weather forecasting, *GALE, Weather, Precipitation, Snow, Rainfall, Storms, Field tests.

The field phase of the Canadian Atlantic Storms Program (CASP) was conducted from 15 January to 15 March 1986. The principal objective of the meteorological component of the program was to begin the process of improving the understanding and prediction of mesoscale features within East Coast storms as well as the storms themselves. The project area, instrumentation platforms used, real-time forecasts, and the linkage of the program to the American Genesis of Atlantic Lows Experiment (GALE) are discussed. Sixteen storms were sampled during the field phase. A number of mesoscale features such as fronts, precipitation bands, heavy snow, and freezing precipitation were sampled. These features and the storms themselves will be studied over the next several years. It is anticipated that scientific progress in understanding the nature of these winter systems and experience gained with new forecasting tools will lead to improved weather forecasts. (Author's abstract)
W87-09255

SCPP METEOROLOGICAL AND STATISTICAL SUPPORT FOR PERIOD 1 SEPTEMBER 1985, 31 AUGUST 1986, VOLUME I: INTERIM PROGRESS REPORT,
Electronic Techniques, Inc., Fort Collins, CO.
A. W. Huggins, R. M. Rauber, T. F. Lee, A. P. Kuciauskas, and G. L. Hemmer.
September 1986. 411 p, 210 fig, 68 tab, 55 ref, 3 append. Bureau of Reclamation Contract No. 4-CR-81-03860.

Descriptors: *Precipitation, *Meteorology *Statistical analysis, *Sierra Nevada, *Weather modification, *Cloud seeding, Forecasting, Model studies, Statistical models, Storms, Clouds, Orographic precipitation, Radar.

Operational and scientific contributions to the Sierra Cooperative Pilot Project (SCPP) are documented, and operational methods and data procedures are briefly described. The fist articles describe the status of the SCPP targeting model, present targeting results from past seeding cases and describe important changes to be made to the model. The next articles discuss three case studies involving airborne seeding designed to impact a

fixed target. The cases describe the synoptic, meso, and microscale structure of the storm with emphasis on the natural cloud evolution and the effects of seeding. A model for the evolution of large (>150 micromn) cloud droplets is presented in one of these cases. A subsequent article deals with climatological investigations of a variety of meteorological parameters and shows how the seasonal or diurnal distribution of these parameters effect seeding opportunity. The final article compares supercooled liquid water measurements before and after frontal rainband passages and discusses short term forecasting these events using radar. A series of four articles concludes the analyses. One discusses diurnal trends in radiometer data. The second presents results of analyzing precipitation data (observed versus predicted) from past ground seeding operations by the Sacramento Municipal Utility District. The third shows another technique for analyzing precipitation data downwind of seeding using 15-min data maps. The final article presents results of an experiment where three forecasters attempted to forecast the occurrence of supercooled liquid water near the crest of the American River Basin. (Author's abstract)
W87-09334

DECREASE IN PRECIPITATION ACIDITY RESULTING FROM DECREASED S04(2-) CONCENTRATION,
Yale Univ., New Haven, CT. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W87-09348

FREE AMINO ACIDS IN MARINE RAINS: EVIDENCE FOR OXIDATION AND POTENTIAL ROLE IN NITROGEN CYCLING,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
K. Mopper, and R. G. Zika.
Nature NATUAS, Vol. 325, No. 6101, p 246-249. January 1987. 1 fig, 2 tab, 18 ref. NSF Grants OCE-8411781 and ATM-8405291, and Office of Naval Research Grant N00014-85-C-0020.

Descriptors: *Amino acids, *Precipitation, *Chemistry of precipitation, *Oxidation, *Nitrogen cycle, *Marine environment, Nutrients.

Analyses of specific organic nitrogen compounds within precipitation can yield new information about sources and transformations of dissolved organic nitrogen (DON) as well as about heterogeneous oxidative processes in the atmosphere. Dissolved free amino acids (DEAA) are a class of compounds for which surprisingly few analysis in precipitation have been published. The first detailed analyses of DFAA and primary amines in marine rains are reported here. Unexpectedly high concentrations of total DFAA were measured, averaging about 6.5 microM (16 marine rain samples) and ranging from 1.1 to 15.2 microM (0.015 to 0.21 p.p.m.N.); these values are similar to those obtained for inorganic nitrogen species. Amino acids are predominantly found in rain as their L optical isomers and therefore are most likely biological in origin; however, the exact sources and models of enrichment in rain over the open ocean are not known. There is evidence that some of the amino acids, in particular methionine, are oxidized in the atmosphere possibly by a heterogeneous photochemical pathway. The finding of high DFAA and primary amine concentrations in marine rain may have important implications in global nitrogen cycling and also may contribute locally to available nitrogen at the sea surface. (Author's abstract)
W87-09349

FATE OF SOME COMPONENTS OF ACIDIC DEPOSITION IN OMBROTROPHIC MIRES,
Dept. of Botany, Univ. of Manchester, Manchester M13 9PL, Great Britain.
For primary bibliographic entry see Field 5B.
W87-09382

EFFECTS OF SIMULATED ACIDIC MIST ON GERMINATION OF ALTERNARIA SOLANI AND PHYTOPHTHORA INFESTANS IN VITRO AND THEIR INFECTION EFFICIENCY AND SPORULATION ON POTATO,
Boyce Thompson Inst. for Plant Research, Ithaca, NY.
For primary bibliographic entry see Field 5C.
W87-09414

CLIMATE FORECAST VERIFICATIONS, U.S. MAINLAND, 1974-82,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
R. W. Preisendorfer, and C. D. Mobley.
NOAA Technical Memorandum ERL PMEL-36, September 1982. 235 p, 55 fig.

Descriptors: *Precipitation, *Temperature, *Weather forecasting, *Forecasting, *Climate forecasting, Prediction, Climatology, Stochastic process, Maps, Analog models.

The predictability of temperature and precipitation forecasts for the U.S. mainland was studied, using records of 33 seasons (Dec. 1973 to Feb. 1982) drawn from human forecasters, working separately: the Analoger and groups at Scripps Institution of Oceanography, National Weather Service, and Creighton University. Three non-human forecasters (Climater, Persister, and Stochaster) were used to set benchmarks for performance. Several non-human empirical forecasters included for comparison were the Pure Analoger, Persistence Analoger, Best Analoger, Empirical Markover, Most Probable Markover, and Hybrider. Winter 1982 precipitation was least well predicted of the past five winters. Winter 1982 temperature was less well predicted than the winter 1981 temperature. In general, temperature was better predicted than precipitation. Both precipitation and temperature were best predicted in winter, followed in order by spring, summer, and fall. Temperature was better predicted on the Pacific Coast, Southwestern Desert, and Northern Plains; less well predicted in the Southern Plains, Gulf Coast, and Atlantic Coast. Precipitation was better predicted in the Southwestern Desert, Great Northern Basin, and Great Lakes; less well predicted in the Southern Plains, Gulf Coast, and Atlantic Coast. The human forecasters were generally better than the Stochaster and the Climater, but they were often no better than the Persister. The best of all operational forecasters was the Most Probable Markover. (Cassar-PTT)
W87-09499

DATA INTERCOMPARISON THEORY I. MINIMAL SPANNING TREE TESTS FOR LOCATION AND SCALE DIFFERENCES,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 7C.
W87-09501

DATA INTERCOMPARISON THEORY V. CASE STUDY: EFFECTS OF OBJECTIVE ANALYSIS ON A TROPICAL PACIFIC SEA SURFACE TEMPERATURE SET,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 7C.
W87-09502

DATA INTERCOMPARISON THEORY IV. TERCILE TESTS FOR LOCATION, SPREAD AND PATTERN DIFFERENCES,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 7C.
W87-09503

DATA INTERCOMPARISON THEORY II. TRINITY STATISTICS FOR LOCATION, SPREAD AND PATTERN DIFFERENCES,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 7C.
W87-09504

DATA INTERCOMPARISON THEORY III. S-PHASE AND T-PHASE TESTS FOR SPATIAL PATTERN AND TEMPORAL EVOLUTION,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 7C.
W87-09505

2C. Snow, Ice, and Frost

POINT PROBABILITY DISTRIBUTIONS OF FROZEN SOIL,
Agricultural Research Service, Pendleton, OR. Columbia Plateau Conservation Research Center.
J. F. Zuzel, J. L. Pikul, and R. N. Greenwalt.
Journal of Climate and Applied Meteorology, JCAMEJ, Vol. 25, No. 11, p 1681-1686. 5 fig, 3 tab, 21 ref.

Descriptors: *Model studies, *Frost, *Soil erosion, *Frozen ground, *Statistical models, *Statistical studies, *Pacific Northwest, Runoff, Erosion, Sedimentation, Simulation.

In some areas of the Pacific Northwest, frozen soils play a major role in surface runoff, soil erosion and sedimentation, but quantitative descriptions of the frequency and severity of soil frost are lacking. The temporal characteristics of frozen soil in north-central Oregon were quantified by using a soil frost simulation model to calculate the presence or absence of soil frost 80 percent of the time for a five year field calibration period. November through March simulation results for a 30 year time period showed that frozen soil occurred every year, and the soil was frozen an average of 57 years per year. The highest incidence of frozen soil occurs during January when the soil is frozen 60 percent of the time followed closely by February (53 percent) and December (51 percent). The number of freeze thaw cycles other than diurnal cycles varied from one to seven per annum with an average of three per annum for the simulation period. (Author's abstract)
W87-08696

NUMERICAL SIMULATION OF THE EFFECTS OF VARYING ICE CRYSTAL NUCLEATION RATES AND AGGREGATION PROCESSES ON OROGRAPHIC SNOWFALL,
Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 2B.
W87-08697

SNOW FORECASTS FROM THE METEORLOGICAL OFFICE FINE-MESH MODEL DURING THE WINTER OF 1985/86,
Meteorological Office, Bracknell (England).
For primary bibliographic entry see Field 2B.
W87-08702

SUPPLY OF SNOW IN THE EASTERN HIGHLANDS OF SCOTLAND: 1954-5 TO 1983-4,
R. W. Davison.
Weather WTHRAL, Vol. 42, No. 2, p 42-50, February 1987. 4 fig, 5 tab, 15 ref.

Descriptors: *Snow, *Skiing, *Snow accumulation, *Scotland, *Precipitation, *Snow skiing, Recreation, Blowing snow, Drifting snow, Accumulation, Data interpretations, Weather, Wind velocity, Wind.

As part of a project to measure the natural potential of sites in the Eastern Highlands of Scotland for downhill skiing, data were required on the supply of snow at an altitude of 800 meters. The methods employed for the measurement of snowfall and wind speed were described and the main characteristics of the supply of snow in the area over the period 1954-5 to 1983-4 were identified.

The accuracy of the data was determined. Interpretation of the results suggests three main features of the supply of snow: (1) great temporal and directional variability, but no particularly dominant month or wind direction; (2) a major change in its characteristics in the 1960s; and (3) increasing snowdrift and storminess since the late 1970s. The implications of the results for ski areas were presented. (Wood-PTT)
W87-08810

PHOTOSYNTHATE DISTRIBUTION BY MICROPLANKTON IN PERMANENTLY ICE-COVERED ANTARCTIC DESERT LAKES,
Montana State Univ., Bozeman. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W87-08872

EFFECT OF POLLUTED AND LEACHED SNOW MELT WATERS ON THE SOIL BACTERIAL COMMUNITY--QUANTITATIVE RESPONSE,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 5C.
W87-08874

SPATIAL VARIABILITY IN THE CHEMICAL COMPOSITION OF SNOWCOVER IN A SMALL, REMOTE, SCOTTISH CATCHMENT,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W87-08945

SEASONAL AND SPATIAL TRENDS IN SOUTH GREENLAND SNOW CHEMISTRY,
New Hampshire Univ., Durham. Inst. for the Study of Earth, Oceans and Space.
For primary bibliographic entry see Field 5B.
W87-08946

SCAVENGING OF ATMOSPHERIC SULFATE BY ARCTIC SNOW,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
C. I. Davidson, R. E. Honrath, J. B. Kadane, R. S. Tsay, and P. A. Mayewski.
Atmospheric Environment ATENBP, Vol. 21, No. 4, p 871-882, April 1987. 4 fig, 1 tab, 52 ref. NSF Grant DPP-8315452; EPA Grant APP-0306-1983.

Descriptors: *Air pollution, *Acid rain, *Arctic snow, *Scavenging, *Sulfates, *Path of pollutants, *Greenland, Snow, Weather, Meteorology, Seasonal variation, Clouds, Deposition.

Scavenging ratios for sulfate on the south-central Greenland Ice Sheet at Dye 3 have been computed for 1982-1984. The ratios are based on measured concentrations in snow and estimated concentrations in air. The snow data have been obtained from snowpit samples which were dated by comparing delta 18O values with meteorological records. The airborne concentrations have been estimated from data collected at coastal Greenland sites. Scavenging ratios resulting from this process are found to be in the range 100-200 in winter and 200-400 in summer. The greater summer values are attributed to increased riming, resulting in scavenging of sulfate as condensation nuclei and possible oxidation of SO2 in cloudwater droplets. Using the airborne and snowpit concentrations with assumed dry deposition velocities of 0.02-0.05 cm/s, it is estimated that dry deposition is responsible for roughly 10-30% of the total sulfate deposition on a year-round basis at Dye 3. During portions of the Arctic winter, however, when the snow is unrimed and when there is less precipitation, dry deposition may be dominant. (Author's abstract)
W87-08947

TRACE METAL AND STRONG ACID COMPOSITION OF RAIN AND SNOW IN NORTHERN MINNESOTA,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
For primary bibliographic entry see Field 5B.
W87-09178

SUBGLACIAL DRAINAGE FOR AN ICE SHEET RESTING UPON A LAYERED DEFORMABLE BED,
Faculty of Science, Simon Fraser Univ., British Columbia, Canada.
For primary bibliographic entry see Field 2F.
W87-09248

IN SITU COSMOGENIC 3H, 14C, AND 10BE FOR DETERMINING THE NET ACCUMULATION AND ABLATION RATES OF ICE SHEETS,
Scripps Institution of Oceanography, La Jolla, CA.
D. Lal, K. Nishiizumi, and J. R. Arnold.
Journal of Geophysical Research (B) JJGBDU, Vol. 92, No. 6, p 4947-4952, May 1987. 2 fig, 3 tab, 32 ref. NSF Grant DPP-8409526, NASA Grant NAG 9-33, and Cal Space Grant CS-59-86.

Descriptors: *Isotope studies, *Ablation, *Ice sheets, *Tracers, Tritium, Carbon isotopes, Beryllium isotopes, Oxygen, Accumulation, Desposition, Precipitation.

The usefulness of the in situ cosmogenic 3H, 14C, and 10Be produced by spallation of oxygen nuclei in ice, as tracers to determine net accumulation/ablation rates of ice sheets is explored. The application of the in situ 3H and 10Be is severely constrained because at deposition, ice contains appreciable amounts of these isotopes from the atmosphere. The case is much more favorable for 14C, which is not carried with wet precipitations; atmospheric 14C gets mechanically trapped in the ice during deposition. We point out that cosmogenic 14C would probably exist as 14CO in ice. This seems to be supported by the published results of Fireman and Norris. Considering their inherent amounts in the ice and the expected in situ production rates, conditions under which these isotopes can be used to study net accumulation and ablation rates are discussed. Also discussed are available data on 14C and 10Be on polar ice from accumulation and ablation zones. We conclude that 3H and 14C should find wide applications in studying ice dynamics and 10Be in very special circumstances. (Author's abstract)
W87-09249

CONDITIONS FOR CRACK PROPAGATION BY FROST WEDGING,
Purdue Univ., West Lafayette, IN. Dept. of Earth and Atmospheric Sciences.
T. M. Tharp.
Geological Society of America Bulletin BUGMA, Vol. 99, No. 1, p 94-102, July 1987. 10 fig, 2 tab, 53 ref.

Descriptors: *Ice pressured, *Frost, *Rocks, *Crack propagation, Ice, Sedimentary rocks, Crystalline rocks.

A model for frost damage based on the propagation of cracks and joints by pressure exerted by ice formation is examined. Ice pressure is an order of magnitude higher when ice and water pressures remain equal during freezing (confined water) than when free water remains at atmospheric pressure (unconfined water) and adsorptive force conditions prevail. Capillarity generally does not produce stresses of sufficient magnitude to propagate cracks. In coarse-grained porous sedimentary rock, the diameter of pores dictates effective crack aperture and a crack with effectively constant aperture (rectangular crack) results. In other rocks, the aperture of cracks diminishes gradually toward the crack tip (tapered crack). Rectangular cracks more than 1 mm long propagate for short-term confined water conditions, or with stress corrosion, for long-term unconfined water conditions. The tapered cracks of crystalline rock must be 14 cm long to propagate under short-term confined-water freezing and1.4 cm long for long-term loading with unconfined water conditions. Tapered cracks an order of magnitude shorter will propagate with unconfined water if they are connected to a reservoir of unfrozen water allowing adsorptive force suction. Cracks with aspect ratio (maximum aperture/crack length) greater than 0.01 and terminating in sharp crack tips are most susceptible to frost wedging, because ice expansion in these wide cracks causes sufficient dilation to produce critical stress intensity at the crack tip. Some relaxation of ice pressure by plastic flow is expected in wide cracks, but its effect is small. The 9% expansion of ice is not sufficient to propagate short cracks of small aspect ratio. (Peters-PTT)
W87-09350

DETERMINATION OF THE ICE LOAD ON ELEMENTS OF MARINE HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 8A.
W87-09359

HYDRAULIC MODEL STUDY OF PORT HURON ICE CONTROL STRUCTURE,
Cold Regions Research and Engineering Lab., Hanover, NH.
D. J. Calkins, D. S. Deck, and D. S. Sodhi.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-123715, A04 in paper copy, A01 in microfiche. CRREL Report 82-34, November 1982. 59 p, 36 fig, 15 tab, 9 ref, 3 append.

Descriptors: *Model studies, *Hydraulic models, *Hydraulic designs, Hydraulic structures, Ice, Floating ice, Ice drift, Great Lakes, Lake Huron.

Studies were conducted to evaluate various methods for ice control at the outlet of Lake Huron because of potential problems associated with extended winter navigation in this area. Specifically, the results of a refrigerated hydraulic model study for determining the optimum siting of an ice control structure (ICS) are presented. The ice discharge through an opening in an ice control structure was documented to be a function of the floe size, ice type, ice floe conditions and vessel direction. The model data for the average ice discharge per vessel transit scaled to prototype values compared favorably with the data taken at the St. Marys River ICS. The model results of the force measurements were also consistent with data taken at the St. Marys ICS. The dynamic loading conditions were independent of vessel direction. (Halterman-PTT)
W87-09473

WINTER FLOW, ICE, AND WEATHER CONDITIONS OF THE UPPER ST. LAWRENCE RIVER, 1971-81; VOLUME I: ICE COVER CHARTS (PART A),
Clarkson Coll. of Technology, Potsdam, NY.
For primary bibliographic entry see Field 2E.
W87-09475

2D. Evaporation and Transpiration

BARE SOIL EVAPORATION NEAR A SURFACE POINT-SOURCE EMITTER,
Arizona Univ., Tucson. Dept. of Soil and Water Science.
A. D. Matthias, R. Salehi, and A. W. Warrick.
Agricultural Water Management AWMADF, Vol. 11, No. 3/4, p 257-277, September 1986. 5 fig, 6 tab, 20 ref.

Descriptors: *Trickle irrigation, *Measuring instruments, *Field tests, *Soil water, *Evaporation, *Irrigation, Lysimeters.

Two field studies were conducted to estimate bare soil evaporation for 7 days following surface trickle irrigation from a point-source emitter. A microlysimeter method and an infrared thermometer method were used to estimate evaporation at several sites within both wetted and non-wetted areas surrounding the emitter. Based on data from both methods, evaporation accounted for about 33-40% of the applied water in both studies. Where the soil was wet, the microlysimeter method tended to estimate higher values than the infrared thermometer method. For dry soil conditions the infrared

thermometer method estimates were higher. Agreement between the two methods was good for the cumulative 7-day total evaporation estimates in both studies. (Author's abstract)
W87-08743

SPATIAL VARIABILITY OF SOIL WATER AND EVAPOTRANSPIRATION,
Royal Veterinary and Agricultural Univ., Copenhagen (Denmark). Dept. of Soil and Water and Plant Nutrition.
For primary bibliographic entry see Field 2G.
W87-08815

LEAF THICKNESS AND WATER DEFICIT IN PLANTS: A TOOL FOR FIELD STUDIES,
Dept. of Applied Biology, Cambridge (England).
A. Burquez.
Journal of Experimental Botany, Vol. 38, No. 186, p 109-114, January 1987. 3 fig, 19 ref.

Descriptors: *Leaves, *Water deficit, *Field tests, *Measuring instruments, *Water potentials, Estimating, Micrometers, Vegetable crops, Beans, Ornamentals, Calibrations, Temperature.

A technique was developed for estimating plant water deficits using a relatively inexpensive micrometer to measure leaf thickness. A strong correlation was found between leaf thickness and relative water content (RWC) in Brassica napus, Mirabilis jalapa, Phaseolus vulgaris, and Impatiens parviflora. Although leaf thickness at a given RWC varied between plants, it increased linearly with leaf RWC, the rate of change being similar in leaves of plants of the same age and species. Due to this relationship, the construction of a pressure-volume curve makes possible the estimation of leaf water potential. If crude values of relative water content are adequate, a general calibration equation for the population can predict the expected values within reasonable error limits. If very fine values are required, changes in leaf thickness can be followed for each individual; at the end of the experiment, the leaf can be detached and a unique pressure-volume curve generated for it. This latter method eliminates the variance added by pooling the responses of leaves with different thicknesses at full turgor. The technique is particularly useful in field conditions where other techniques are not reliable because of difficulties in controlling temperature and where non-destructive measurements are required. (Author's abstract)
W87-08847

PHYSIOLOGICAL RESPONSES TO DROUGHT OF LOLIUM PERENNE L.: MEASUREMENT OF, AND GENETIC VARIATION IN, WATER POTENTIAL, SOLUTE POTENTIAL, ELASTICITY AND CELL HYDRATION,
Crop Genetics Group, Aberystwyth (Wales). Welsh Plant Breeding Station.
H. Thomas.
Journal of Experimental Botany, Vol. 38, No. 186, p 115-125, January 1987. 2 fig, 5 tab, 19 ref.

Descriptors: *Drought, *Lolium, *Plant physiology, *Water potentials, *Solute potential, *Elasticity, *Hydration, Leaves, Turgidity, Osmotic pressure.

Clonally-replicated genotypes of Lolium perenne were grown in a controlled environment. Leaf water potential, osmotic potential, turgor potential, elasticity (E), leaf hydration (H), and number of green leaves per tiller (N sub GL) were measured before and during a 42-day drought treatment. A simplified method of estimating E using only six measurements was developed to permit a measurement rate of 8 leaves per hour. Measurement errors in all characters were 3% or less. During drought, leaf water potential and osmotic potential decreased significantly, turgor and E increased significantly, and H decreased slightly. Plant size during drought was negatively correlated with osmotic potential and H, and positively correlated with turgor potential, osmotic adjustment, E, and N sub GL. Measurements made on the genotypes before droughting did not give a reliable indication of their physiological condition after adaptation to drought. The possibilities for, and effectiveness of, divergent selection of genotypes with high and low expression of the characters are discussed. (Author's abstract)
W87-08848

SPRING WHEAT GROWTH AT HIGH AND LOW SOIL WATER WITH CONSTRICTED UPPER ROOTS,
South Dakota State Univ., Brookings. Dept. of Plant Science.
E. M. White.
Soil Science SOSCAK, Vol. 143, No. 1, p 44-49, January 1987. 1 fig, 3 tab, 22 ref.

Descriptors: *Wheat, *Growth, *Soil water, *Roots, *Plant physiology, *Soil-water-plant relationships, *Water stress, Greenhouses, Stress, Evapotranspiration, Crop production, Crop yield, Leaves, Soil types.

Characteristics of spring wheat grown at high and low soil moisture levels was studied with and without constricting forces on the upper parts of roots to determine whether growth may result from adaptation to soil-desiccation contraction forces that constrict roots. If water transport is hindered, the effect of root constriction on plant growth should parallel growth at low, in comparison with high, soil moisture. This was found to be correct in some cases, although stresses from high evapotranspiration probably masked the effect of the constricting force in other cases. Heading was accelerated in some plantings by a root constricting force of 0.6 MPa or by allowing the soil to dry between waterings. Straw and grain weights tended to be larger (but not significantly) for plants treated with either pressure or high soil water. Fewer main roots, seminal plus nodal, were produced with root constriction, but grain and straw yields were reduced. (Author's abstract)
W87-08893

SOIL WATER EVAPORATION COMPARISONS AMONG TILLAGE PRACTICES IN THE NORTHERN GREAT PLAINS,
Agricultural Research Service, Sidney, MT.
J. K. Aase, and D. L. Tanaka.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 436-440, March-April 1987. 6 fig, 2 tab, 27 ref.

Descriptors: *Tillage effects, *Soil water, *Evaporation, *Water conservation, Loam, Montana, Great Plains, Soil properties, Rainfall, Irrigation, Lysimeters, Soil cores.

Four tillage practices were studied to find if any one is more efficient than another for conserving soil water in the top 0.1 m of a soil profile during the mid-summer months of fallow in the northern Great Plains. The study was conducted on a Williams loam (fine-loamy mixed, Typic Argiboroll) 11 km northwest of Sidney, MT. The treatments, replicated three times, were: (i) bare fallow, (ii) stubble-mulch fallow, (iii) chemical fallow-mixed standing and flat residue, and (iv) chemical fallow-flat residue. At the outset there were 3500 and 1100 kg/ha of standing and flat residue, respectively. Following rains > 3 mm and one 40-mm irrigation, three soil cores were taken to a 0.1-m depth from each plot at predetermined intervals and composited. The most rapid initial drying occurred on bare fallow plots, generally followed by stubble-mulch fallow plots, standing and flat straw plots, and flat straw plots. The average initial drying rates were about 1.9, 1.8, 1.4, and 1.2 mm/d, respectively. Differences due to treatments no longer existed after about 10 d. The data, as well as data from two precision weighing lysimeters (one bare-fallowed and the other chemically-fallowed), suggest that soil water evaporation during the summer months in the northern Great Plains is about the same from all tillage treatment tested. (Author's abstract)
W87-09006

SIMULATION OF THE HYDROLOGIC CYCLE FOR WATERSHEDS,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 2A.
W87-09111

RESPONSES OF LEAF WATER POTENTIAL AND LEAF DIFFUSIVE RESISTANCE TO ABSCISIC ACID, WATER STRESS AND LOW TEMPERATURE IN HIBISCUS ESCULENTUS: THE EFFECT OF WATER STRESS AND ABA PRE-TREATMENTS,
University of the South Pacific, Suva (Fiji). Dept. of Biology.
D. Eamus.
Journal of Experimental Botany, Vol. 37, No. 185, p 1854-1862, December 1986. 3 fig, 30 ref.

Descriptors: *Water potentials, *Leaves, *Water stress, *Temperature effects, *Abscisic acid, *Okra, *Diffusive resistance, Stress, Temperature, Stomata, Wilting, Resistance, Evapotranspiration.

Intact plants of okra were chilled at 6 C in the light, and leaf diffusion resistance (LDR) and leaf water potential measured. The response of the LDR of excised leaves to fresh weight loss and, separately, exogenous abscisic acid (ABA) supply was studied at 6 C and 30 C. Plants that had been grown in a high humidity environment continuously (designated control plants) had stomata that were very unresponsive to both water loss from the leaves and to exogenous ABA at both 6 C and 30 C. Chilling the control plants resulted in rapid wilting and decline in leaf water potential. A pre-treatment of water stress prior to chilling did not alter or reduce the rate of development of chilling injury, nor did the pre-treatment increase the responsiveness of stomata at 6 C to water loss or exogenous ABA. However, spraying the leaves with ABA prior to chilling reduced the severity and delayed the onset of chilling injury. Stomatal response to water stress and exogenous ABA was increased by the spraying pre-treatment. These results are discussed in relation to previous studies of the phenomenon of stomatal locking open at low temperature and the effect of pre-treatments upon the development of chill-resistance. (Author's abstract)
W87-09210

ADVANCES IN IRRIGATION, VOLUME 3.
Massachusetts Univ., Amherst. Dept. of Plant and Soil Sciences.
For primary bibliographic entry see Field 3F.
W87-09464

ESTIMATING EVAPOTRANSPIRATION,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
M. L. Sharma.
IN: Advances in Irrigation, Volume 3. Academic Press, Orlando, Florida, 1985. p 213-281, 10 fig, 3 tab, 207 ref.

Descriptors: *Models, *Evapotranspiration, *Irrigation efficiency, *Reviews, *Evaporation, Mathematical models, Transpiration, Irrigation practices, Spatial distribution, Water management, Advection, Vegetation effects, Temporal distribution.

An overview of evapotranspiration considering various measurement and modeling approaches is presented. An understanding of evapotranspiration requires expertise from several disciplines. When studying the meterological aspects of evapotranspiration, consideration must also be given to local soil-vegetation conditions, the availability of energy, transfer of water vapor, and potential evapotranspiration. The mechanisms involved in evapotranspiration are examined in terms of evaporation from the soil surface, evaporation of intercepted water, and water loss by transpiration. Water management problems such as planning for irrigation scheduling may require quantification of evapotranspiration for an area of soil-vegetation over a period of time. Water balance, micrometeorological, and plant physiological methods of evapotranspiration measurement are to be described. No single method of measuring evapotranspiration can be applicable under all conditions. The modeling approach of evapotranspiration can range from a

process-oriented, physically based model to a black-box, single-parameter, correlation-based model. Models for potential and reference evapotranspiration and for actual evapotranspiration are discussed. Spatial heterogeneity of advection and some aspects of vegetation and soils may affect the estimation of areal evapotranspiration. (Geiger-PTT)
W87-09469

2E. Streamflow and Runoff

GENERALIZED METHOD OF MOMENTS AS APPLIED TO PROBLEMS OF FLOOD FREQUENCY ANALYSIS: SOME PRACTICAL RESULTS FOR THE LOG-PEARSON TYPE 3 DISTRIBUTION,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
F. Ashkar, and B. Bobee.
Journal of Hydrology JHYDA7, Vol. 90, No. 3/4, p 199-217, April 1987. 5 tab, 21 ref. NSERC (Canada) Operating grants A-8399, A-5797 and Strategic grant G-1617.

Descriptors: *Statistics, *Time series analysis, *Flood frequency, *Data interpretation, *Monte Carlo method, *Estimating, Design flood, Correlation analysis, Distribution, Floods.

The log-Pearson type 3 distribution is widely used in North America and Australia for fitting annual flood series. Four different versions of the method of moments used in fitting this distribution are compared using Monte Carlo simulated samples which reflect some of the characteristics of annual flood series observed at some Canadian rivers. The bias, standard error, root mean square error, and skew, of the parameter estimates, and of estimates of events associated with different probabilities of occurrence are examined. Also examined are the correlation coefficients between the parameter estimates and between the sample moments that are used in each of the four methods of estimation. It is observed that variances, covariances and correlation coefficients calculated using the usual first-order asymptotic approximation might have considerable error and therefore should be used with caution. On the basis of mean square error of events with return period above the range covered by the sample it is observed that a method proposed earlier which uses moments of order 1, 2 and 3 in real space performs better than the other three methods although certain of the other methods follow the recommendation put forward by some investigators that higher order moments (moments of order 3 or more) should be avoided in flood frequency estimation. It is argued in the present study that the use of higher order moments should not be avoided simply because they have high variability because it is not only the variability of the moments which determines the degree of variability of the estimated design flood events but also the correlation that exists between these moments. Some recommendations are given at the end of the study aimed at achieving better efficiency in flood frequency research at a period where more and more distributions and methods of estimation are being proposed. (Author's abstract)
W87-08616

APPLICATION OF METEOROLOGICAL RADAR DATA FOR SIMULATION OF STREAMFLOW WITH A HYDROLOGICAL MATRIX MODEL (UTILISATION DES DONNEES D'UN RADAR METEOROLOGIQUE POUR LA SIMULATION DES ECOULEMENTS EN RIVIERE A L'AIDE D'UN MODELE HYDROLOGIQUE MATRICIEL),
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 7B.
W87-08623

EFFECTS OF AN ACIDIC RIVER, CAUSED BY ACIDIC RAIN, ON WEIGHT GAIN, STEROIDOGENESIS, AND REPRODUCTION IN THE ATLANTIC SALMON (SALMO SALAR),
Halifax Fisheries Research Lab. (Nova Scotia). Fisheries and Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W87-08651

HYDROLOGY,
Finkel and Finkel, Yoqneam (Israel).
For primary bibliographic entry see Field 2A.
W87-08662

FLUVIAL HYDROLOGY,
New Hampshire Univ., Durham.
For primary bibliographic entry see Field 2A.
W87-08685

OPEN-CHANNEL HYDRAULICS,
Nevada Univ. System, Las Vegas. Desert Research Inst.
For primary bibliographic entry see Field 8B.
W87-08688

ECOLOGICAL AND STATISTICAL PROGNOSIS OF THE DYNAMICS OF FISH CATCH BASED ON DENDROCHRONOLOGICAL DATA,
For primary bibliographic entry see Field 2H.
W87-08711

GROWTH AND SURVIVAL OF GIANT RAGWEED (AMBROSIA TRIFIDA L.) IN A DELAWARE RIVER FRESHWATER TIDAL WETLAND,
Rutgers Univ., Camden, NJ. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W87-08714

HEAVY METAL POLLUTION IN THE PARAIBA DO SUL RIVER, BRAZIL,
Universidade Federal do Rio de Janeiro (Brazil). Inst. de Biofisica.
For primary bibliographic entry see Field 5B.
W87-08718

CHEMISTRY OF THE RIVER NIGER I. MAJOR IONS,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 2K.
W87-08719

CHEMISTRY OF THE RIVER NIGER II. TRACE METALS,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 2K.
W87-08720

NATURE OF ORGANIC MATTER IN RIVERS WITH DEEP SEA CONNECTIONS: THE GANGES-BRAHMAPUTRA AND INDUS,
Hamburg Univ. (Germany, F.R.). SCOPE/UNEP International Carbon Unit.
For primary bibliographic entry see Field 2H.
W87-08721

SOIL WATER BALANCE MODEL FOR SLOPING LAND,
Whatawhata Hill Country Research Station, Hamilton (New Zealand).
For primary bibliographic entry see Field 2A.
W87-08735

LIFE CYCLES OF FOUR SPECIES OF BAETIS (EPHEMEROPTERA) IN THREE DANISH STREAMS,
Copenhagen Univ. (Denmark). Freshwater Biological Lab.
For primary bibliographic entry see Field 2H.
W87-08764

BENTHIC MACROINVERTEBRATES OF THE MEUSE RIVER IN BELGIUM: A REVIEW OF FIVE YEARS OF RESEARCH (1980-1984) (LES MACROINVERTEBRES BENTHIQUES DE LA MEUSE BELGE: BILAN DE CINQ ANNEES DE RECHERCHES (1980 A 1984),
Facultes Universitaires Notre-Dame de la Paix, Namur (Belgique). Unite d'Ecologie des Eaux Douces.
For primary bibliographic entry see Field 5C.
W87-08765

COUNTING THE DAYS ALONG LAKE MICHIGAN,
For primary bibliographic entry see Field 2J.
W87-08804

NEW PROCEDURES FOR FLOOD ESTIMATION IN NORWAY,
Norwegian Water Resources and Energy Administration, Oslo (Norway).
N. R. Saelthun, and J. H. Andersen.
Nordic Hydrology NOHYBB, Vol. 17, No. 4/5, p 217-228, 1986. 18 ref.

Descriptors: *Flood estimation, *Flood control, *Dam design, *Dams, *Floods, *Flooding, Norway, Flood protection, Floodproofing, Regulations, Dam construction.

The development of new procedures for flood estimation for dam design in Norway was described. The regulations and recommendations for flood calculations set forth by 'The Norwegian Regulations for Planning, Construction and Operation of Dams' and the recent guidelines issued by the Hydrological Department of the The Directorate of Water Resources were summarized. It was concluded that the greatest uncertainties in the flood calculation procedures were connected to the application of the areal reduction factor for large catchments since the commonly used areal reduction curves are based on fixed area analysis and rainfall events of moderate return period. (Wood-PTT)
W87-08811

MODELLING WATER EXCHANGE AND TRANSIT TIMES IN TILL BASINS USING OXYGEN-18,
Sveriges Meteorologiska och Hydrologiska Inst., Norrkoeping.
For primary bibliographic entry see Field 2A.
W87-08821

RUNOFF STUDIES IN A SMALL CATCHMENT,
Oslo Univ. (Norway). Inst. for Geophysics.
S. Myrabo.
Nordic Hydrology NOHYBB, Vol. 17, No. 4/5, p 335-346, 1986. 6 fig, 12 ref.

Descriptors: *Runoff, *Rainfall-runoff relationships, *Runoff forecasting, *Catchment areas, Catchment basins, Forecasting, Norway, Precipitation, Snowmelt, Hydrography, Hydrographs, Saturated soils, Soil water, Overland flow, Rainfall, Model studies.

Results from a field study in a small East-Norwegian catchment were discussed. The different runoff processes in a small catchment were separated. Direct measurement of precipitation, snowmelt, runoff and the saturates basin area were undertaken in the field together with chemical hydrograph separation. A functional relation between saturated area and runoff was established showing that the initial runoff is a good moisture indicator for a basin. Further, the hydrograph of pure saturated overland flow (produced from rain on the saturated area) may be separated from the rest of the runoff at any moment of time. The results were discussed in view of existing methods of estimating soil moisture and forecasting runoff. It was concluded that the dynamic response area should be taken into consideration both in field investigations and in hydrological models, especially in humid climate. (Author's abstract)
W87-08822

WATBAL: A SEMI-DISTRIBUTED, PHYSICALLY BASED HYDROLOGICAL MODELLING SYSTEM,
Danish Hydraulic Institute, Horsholm.
For primary bibliographic entry see Field 2G.
W87-08823

OPERATIONAL SPRING TIME FORECASTING DIFFICULTIES AND IMPROVEMENTS,
National Board of Waters, Helsinki (Finland).
B. Vehvilainen.
Nordic Hydrology NOHYBB, Vol. 17, No. 4/5, p 363-370, 1986. 2 fig, 3 tab, 6 ref.

Descriptors: *Data interpretation, *Runoff forecasting, *Forecasting, *Model studies, *Annual runoff, *Rainfall-runoff relationships, *Model improvement, Finland, Snowmelt, River basins, Errors, Rainfall, Thaw, Hydrologic models, Statistical models.

A modified version of HBV-3 model has been used since 1981 for operational spring-time forecasting in Finland. This model is ready now for eleven river basins ranging from 500 to 30,000 sq km. From experience with these models in forecasting, the common difficulties and errors in real-time forecasting were recognized and some methods to improve forecasting results were developed. The main difficulties with forecasting during spring time under Finnish conditions were: unstable parameters in snowmelt models, heavy unforecasted rainfall, and evaluation of areal water equivalent of snow and ice dams in rivers. The methods to overcome these difficulties are: the development of more physically-based snowmelt models, the development of new methods to determine initial value of areal water equivalent of snow, the use of statistical error models with hydrological and meteorological data, and the improvement of areal precipitation calculations. (Author's abstract)
W87-08824

TRANSFORMATION OF INPUT TO A STOCHASTIC MODEL USING A DISTRIBUTION DETERMINISTIC MODEL,
National Energy Authority, Reykjavik (Iceland).
A. Snorrason, and K. Einarsson.
Nordic Hydrology NOHYBB, Vol. 17, No. 4/5, p 371-382, 1986. 3 fig, 4 tab, 22 ref.

Descriptors: *Streamflow forecasting, *Model studies, *River flow, *Data interpretation, *Model improvement, *Model testing, Mathematical equations, Mathematical studies, Basins, Iceland.

In recent years, hydrologists have attempted, with encouraging results, to synthesize the accomplishments of time series analysis and deterministic systems methods into the more general framework of stochastic dynamic systems. An improvement of a stochstic time series model by the use of inputs generated by a distributed, deterministic model is described. The analysis is based on a simplified transfer function-noise model, where the system output is modeled as a linear combination of present and past inputs and well as past outputs. The systems chosen for the analysis are two partially glaciated basins in Iceland. The results were in general promising and showed that a careful selection of input series could overcome to a great extent the non-linearities as well as the non-stationarities in the relationship between discharge and meteorological variables. The results showed that transformation of the meteorological series using distributed, deterministic techniques gave superior results, compared with the standard degree-day approach. (Author's abstract)
W87-08825

RIVER FLOW WITH EXCESSIVE SUSPENDED SEDIMENT LOAD: AN EVALUATION OF TURBULENT FLOW CHARACTERISTICS,
Lulea Univ. of Technology (Sweden).
P. Andreasson, and A. Sellgren.
Nordic Hydrology NOHYBB, Vol. 17, No. 4/5, p 383-390, 1986. 8 fig, 11 ref.

Descriptors: *Sediment transport, *Hydrodynamics, *River flow, *Channel flow, *Suspended sediments, *Sediment load, *Turbulent flow, *Flow characteristics, Flow, Rivers, Silt, Sediments, Non Newtonian flow, Rheology, Solids, Viscometers, Measuring instruments.

River flows with high volume concentrations (20-50%) of silty sediments generally imply that the mixture has non-Newtonian properties. The rheological behavior of mixtures with solid particles smaller than 0.1 millimeters was identified experimentally with viscosimeters. Characteristic flow parameters, such as energy losses and depths, were then determined in several examples for turbulent open channel flows. (Author's abstract)
W87-08826

LATERAL MIXING IN CHANNELS DUE TO SECONDARY CURRENTS,
Uppsala Univ. (Sweden). Div. of Hydrology.
R. Larsson.
Nordic Hydrology NOHYBB, Vol. 17, No. 4/5, p 391-398, 1986. 5 fig, 5 ref.

Descriptors: *Hydrodynamics, *Turbulent flow, *Channel flow, *Channels, *Water currents, *Mixing, *Secondary currents, *Lateral mixing, Mathematical studies, Mathematical equations, Mathematical analysis, Downstream, Velocity, Eddy diffusion, Simulation.

Different mechanisms generating secondary currents in channels are presented. It is shown by an order-of-magnitude analysis that secondary currents of magnitude 1% of the downstream velocity are as important for lateral mixing as turbulent diffusion. It is shown that, because distance for cross-sectional mixing increases linearly with the width when the secondary currents are important but is proportional to the square of the width when mixing is due only to diffusion, the relative importance of the secondary currents increases with the width of the channel as well as with the distance from the source to the center of the channel. Results from numerical simulations that support the analysis are presented. (Wood-PTT)
W87-08827

SHIFTING OF THE KOSI RIVER, NORTHERN INDIA,
Kent State Univ., OH. Dept. of Geology.
N. A. Wells, and J. A. Dorr.
Geology GLGYB, Vol. 15, No. 3, p 204-207, March 1987. 3 fig, 2 tab, 33 ref.

Descriptors: *Aggradation, *Alluvial fans, *Alluvial plains, *Kosi River, *India, *Aggrading rivers, *Geomorphology, *Channel shifting, *Watersheds, Catchment areas, Banks, Rivers, *Channel migration, Channels, Floodwater, Drainage, Floods, Stochastic process, Earthquakes, Sediments, Soil types, Sand.

The Kosi River shifts laterally over the Himalaya foreland plain by continual minor cutoffs and bank cutting and by episodic major shifts across watersheds, by moving into and then out of preexisting, adjacent, less actively aggrading streams. Migration is unidirectional because after a channel is filled to instability, floodwater will drain preferentially into a new adjacent low rather than across it to the next watershed or back to the last abandoned channel. Major shifts seem stochastic and autocyclic; they do not correlate with the many severe quakes and floods that undoubtedly helped prime the system for shifts. The river should shift west (off-fan into new lows), one watershed at a time, until it meets an equal river moving east or cannot move farther uphill. Unable to move on, it would build to unstable levels relative to its last channel and sweep back over its fan. Progressive shifting could deposit multistory sands (superposed overfit channels from overwhelming and underfit channels and oxbows from abandonment) marked by changes in discharge and provenance but not paleocurrent directions. (Author's abstract)
W87-08834

THEORY OF SECONDARY PRODUCTION CALCULATIONS FOR CONTINUOUSLY REPRODUCING POPULATIONS,
Melbourne Univ., Parkville (Australia). Dept. of Zoology.
For primary bibliographic entry see Field 2L.
W87-08862

SESTONIC BACTERIA AS A FOOD SOURCE FOR FILTERING INVERTEBRATES IN TWO SOUTHEASTERN BLACKWATER RIVERS,
Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W87-08870

ROLE OF GAS EXCHANGE IN THE INORGANIC CARBON, OXYGEN, AND 222RN BUDGETS OF THE AMAZON RIVER,
Washington Univ., Seattle. School of Oceanography.
For primary bibliographic entry see Field 2H.
W87-08871

ACUTE TOXICITY OF BRESTAN AND FENTIN ACETATE ON SOME FRESHWATER ORGANISMS,
For primary bibliographic entry see Field 5C.
W87-08876

ORGANOCHLORINE PESTICIDE RESIDUES IN FISH FROM THE SHATT AL-ARAB RIVER, IRAQ,
The University, Basrah (Iraq). Dept. of Environmental Marine Chemistry.
For primary bibliographic entry see Field 5B.
W87-08880

RESEARCH IN ENVIRONMENTAL POLLUTION: II. DETERMINATION OF POLYCHLORINATED NITROBENZENES (PCNB'S) IN MAIN RIVER FISH,
Hessische landwirtschaftliche Versuchsanstalt, Darmstadt (Germany, F. R.).
For primary bibliographic entry see Field 5A.
W87-08895

RESIDUES OF ORGANOCHLORINE PESTICIDES IN ENVIRONMENTAL SAMPLES FROM THE SHATT-AL-ARAB RIVER, IRAQ,
Basrah Univ. (Iraq). Marine Science Center.
For primary bibliographic entry see Field 5B.
W87-08910

ASBESTOS FIBRES INTRODUCE TRACE METALS INTO STREAMWATER AND SEDIMENTS,
British Columbia Univ., Vancouver. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W87-08912

TRANSPORT OF SOLIDS IN STREAMFLOW FROM COASTAL PLAIN WATERSHEDS,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
For primary bibliographic entry see Field 2J.
W87-08924

FLOOD DAMAGE MODEL FOR FLOOD PLAIN STUDIES,
Moncton Univ. (New Brunswick). School of Engineering.
N. El-Jabi, and J. Rousselle.
Water Resources Bulletin WARBAQ, Vol. 23, No. 2, p 179-187, April 1987. 8 fig, 12 ref.

Descriptors: *Flood plain management, *Flood damage, Model studies, Hydrology, Hydrodynamics, Economic aspects, Quebec, Calibrations.

Hydrologic and economic information must be integrated in flood plain management. This study describes an integrated approach which includes consideration of the hydrologic, hydrodynamic, physical, and economic components of the total system. On the basis of these components, a theoretical model is proposed which provides a rational

procedure for estimating flood damages from projections of economic development within an area. The utility of the model is demonstrated by applying it to a flood-prone region in Southern Quebec, Canada. (Author's abstract)
W87-08965

LOW DISCHARGE PERIODS OF RIVERS IN THE UPPER VISTULA RIVER BASIN, POLAND,
For primary bibliographic entry see Field 7B.
W87-08970

ESTIMATING BASEFLOW VOLUME AND ITS UNCERTAINTY,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
K. W. Potter, and J. M. Rice.
Water Resources Bulletin WARBAQ, Vol. 23, No. 2, p 233-238, April 1987. 2 fig, 2 tab, 12 ref.

Descriptors: *Data collections, *Data interpretation, *Base flow, *Streamflow, *Discharge measurement, *Low flow, *Recession curve, *Mathematical equations, Estimating, Probabilistic process, Distribution, Volume, Lakes, Hydrologic budget.

By using the exponential baseflow recession equation it is possible to estimate from a single discharge measurement the total volume of stream discharge during a baseflow period. If the discharge measurement is properly centered in the baseflow period the resulting estimate will be fairly precise, even if the baseflow recession coefficient is not known. Furthermore, based on an assumed probability distribution of the baseflow coefficient it is possible to estimate the uncertainty of the baseflow volume estimate. Estimates of baseflow volume and their uncertainty are potentially useful for estimating water budgets of lakes. (Author's abstract)
W87-08971

STEADY-STATE ANALYSIS OF INFILTRATION AND OVERLAND FLOW FOR SPATIALLY-VARIED HILLSLOPES,
Utah State Univ., Logan. Dept. of Forest Resources.
R. H. Hawkins, and T. W. Cundy.
Water Resources Bulletin WARBAQ, Vol. 23, No. 2, p 251-256, April 1987. 3 fig, 2 tab, 20 ref.

Descriptors: *Rainfall-runoff relationships, *Runoff, *Overland flow, *Slopes, *Infiltration, *Rainfall, *Mathematical equations, Model studies, Spatial variation, Probabilistic process.

An envelope of steady-state surface runoff response for a hillslope is established in terms of the probability distribution and spatial arrangement of individual point infiltration capacities and the rainfall intensity. Minimum overland flow is shown to occur when point infiltration capacities are ordered with the highest at the slope bottom, while maximum overland flow occurs when the highest point capacities are at the top of the slope. Equations for envelope curves are developed for both continuous distributions and discretely sampled data; examples for each case are given. Use of the analysis as a rainfall-runoff model is also discussed. (Author's abstract)
W87-08974

USE OF TOPOLOGICAL INFORMATION IN HYDROGRAPH ESTIMATION,
Geological Survey, Denver, CO. Water Resources Div.
M. R. Karlinger, D. P. Guertin, and B. M. Troutman.
Water Resources Bulletin WARBAQ, Vol. 23, No. 2, p 271-279, April 1987. 11 fig, 2 tab, 9 ref.

Descriptors: *Topography, *Discharge hydrographs, *Channel flow, *Basins, *Semiarid regions, Wyoming, Drainage, Rainfall, Volume, Velocity, Calibrations.

Discharge hydrographs computed from the theory of linear flow through topologically random channel networks are compared to actual discharge hydrographs for basins in semiarid regions of central Wyoming. The basins drained by the channel networks range in size from 0.69 to 10.8 square miles. Topological information consisting of stream-network magnitude and link-length distribution parameters are used in calibrating celerity values that ensure that the peak discharge and excess rainfall volume of the resulting computed hydrographs match the peak discharge and excess-rainfall volume of the actual hydrographs. Results indicate that, for a given peak discharge and excess-rainfall volume in a basin, the sensitivity of the calibrated celerity values to excess-rainfall duration is small if the ratio of excess-rainfall volume to peak discharge is at least 1.75 times the excess-rainfall durations. (Author's abstract)
W87-08976

COMPUTATION OF UNSTEADY FLOWS IN THE ALABAMA RIVER,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
H. H. Jeffcoat, and M. E. Jennings.
Water Resources Bulletin WARBAQ, Vol. 23, No. 2, p 313-315, April 1987. 4 fig, 2 ref.

Descriptors: *BRANCH, *Flow models, *Model studies, *Unsteady flow, *Alabama River, *Limnology, Calibrations, Rivers, Flow, Discharge.

An application is described of the branch-network flow model, BRANCH, to the upper Alabama River system in central Alabama. The model is used to simulate one-dimensional unsteady flows and water surface elevation in approximately 60 river miles of the Alabama River system. Preliminary calibration was made using 72 hours of observed data. Simulated discharges are about 10 percent lower than observed discharges at higher discharge rates and computed flows lag observed flows by about 30 minutes. (Author's abstract)
W87-08980

EFFECT OF TILLAGE SYSTEM ON RUNOFF LOSSES OF SURFACE-APPLIED PESTICIDES,
Wisconsin Univ.-Madison. Dept. of Soil Science.
T. J. Sauer, and T. C. Daniel.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 410-415, March-April 1987. 8 tab, 28 ref.

Descriptors: *Path of pollutants, *Simulated rainfall, *Tillage effects, *Corn, *Surface runoff, *Pesticides, Infiltrometers, Erosion, Runoff.

Four tillage systems (conventional, chisel, ridge-plant, and no-till) in continuous corn (Zea mays L.) were compared with respect ot surface runoff losses of atrazine (2-chloro-4-ethyl-amino-6-isopropylamino-s-triazine), alachlor (2-chloro-2,'6'-diethylN(methoxymethyl) acetanilide) and chlorpyrifos (0,0-diethyl-0-(3,5,6-trichloro-2-pyridyl) phosphorothioate). A modified Purdue sprinkling infiltrometer was used to apply simulated rainfalls of 136 and 73 mm during the 1983 and 1984 growing seasons to 1.35-sq m test areas on a Griswold silt loam (Typic Argiudoll). Conservation tillage (CT) systems (chisel, ridge-plant, and no-till) reduced both runoff and soil loss; however, pesticide concentrations in runoff water and sediment for these systems were at times greater than for the conventional (moldboard plow) system. Reduced runoff volumes and erosion with CT systems offset higher pesticide concentrations resulting in few significant tillage treatment differences with respect to total pesticide loss. Maximum loss of active ingredient averaged over all tillage systems was 5.8, 4.0, and 0.2% for atrazine, alachlor, and chlorpyrifos, respectively, when high-intensity simulated rainfall was applied within 7 d of pesticide application. (Author's abstract)
W87-09001

SEMIPORTABLE MULTISLOT DIVISOR FOR EROSION AND RUNOFF MEASUREMENTS,
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
For primary bibliographic entry see Field 7B.
W87-09010

EVALUATION OF NATURAL TRACERS IN AN ACIDIC AND METAL-RICH STREAM,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 7B.
W87-09021

REGULATION OF RIVERINE FISH COMMUNITIES BY A CONTINUUM OF ABIOTIC-BIOTIC FACTORS,
Lodz Univ. (Poland). Inst. of Environmental Biology.
For primary bibliographic entry see Field 2H.
W87-09037

INTRODUCTION TO URBAN HYDROLOGY AND STORMWATER MANAGMENT,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 4C.
W87-09097

DESK-TOP METHODS FOR URBAN STORMWATER CALCULATION,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W87-09100

URBAN RUNOFF PROCESSES,
Camp, Dresser and McKee, Inc., Annandale, VA.
For primary bibliographic entry see Field 2A.
W87-09101

DATA COLLECTION AND INSTRUMENTATION,
Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
For primary bibliographic entry see Field 7B.
W87-09103

OVERVIEW OF URBAN STORMWATER MODELS,
Camp, Dresser and McKee, Inc., Annandale, VA.
For primary bibliographic entry see Field 4C.
W87-09104

EXAMPLE MODEL APPLICATIONS,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 4C.
W87-09105

APPLIED STREAM SANITATION,
For primary bibliographic entry see Field 2H.
W87-09189

HYDROGEOLOGICAL ASPECTS OF AGRICULTURAL DRAINAGE IN IRELAND,
Minerex Ltd., Dun Laoghaire (Ireland).
D. J. Burdon.
Environmental Geology and Water Sciences EGWSEI, Vol. 9, No. 1, p 41-65, 1986. 6 fig, 6 tab, 76 ref.

Descriptors: *Geohydrology, *Agricultural runoff, *Agricultural watersheds, *Drainage, *Ireland, *Legal aspects, *Bogs, Groundwater hydrology, Runoff, Agriculture, Geology, Watersheds, Topography, Chemistry, Infiltration, Aquifers, Marshes, Administrative agencies.

Hydrogeological principles and approaches are applied to the problems of agricultural drainage in Ireland. The legal position and a short history of drainage in Ireland are given, as well as a list of the many state bodies involved in arterial and agricultural drainage. The evolution of the present Irish environment is outlined from the end of the last ice age to the present day, with emphasis on the formation of lands in need of drainage. The ways in which areas now requiring agricultural drainage have been formed are described. Areas of low or nil infiltration are described, and areas afflicted by high, but often diffuse, groundwater discharge are

noted. The effect of bog growth, both raised bogs and blanket bog, are outlined. Some of the harmful effects of drainage are outlined, including reduction of grazing during rare droughts and pollution from bog drainage. Drainage does not deplete the groundwater resources of Ireland, which are abundant and little used. General conclusions are presented along with a list of 13 unusual ideas which arise from the application of hydrogeological principles and approaches to problems of agricultural drainage in Ireland. (Author's abstract)
W87-09203

HEAVY METALS DISTRIBUTION IN THE SEDIMENTS OF GANGES AND BRAHMAPUTRA RIVERS,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W87-09204

MAN-INDUCED GRADIENT ADJUSTMENT OF THE SOUTH FORK FORKED DEER RIVER, WEST TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 6G.
W87-09206

SPRING AND SUMMER MOVEMENTS OF SUBADULT STRIPED BASS, MORONE SAXATILIS, IN THE CONNECTICUT RIVER,
Massachusetts Cooperative Fishery Research Unit. Univ. of Massachusetts, Holdsworth Hall, Amherst, MA 01003.
For primary bibliographic entry see Field 2H.
W87-09253

MODELLING OF BOD-DO DYNAMICS IN AN ICE-COVERED RIVER IN NORTHERN CHINA,
Research Inst. of Environmental Science, Peking Normal Univ., Peking, China.
For primary bibliographic entry see Field 5B.
W87-09262

HYDROLOGICAL AND CHEMICAL FACTORS CONTROLLING THE CONCENTRATIONS OF FE, CU, ZN AND AS IN A RIVER SYSTEM CONTAMINATED BY ACID MINE DRAINAGE,
Applied Geochemistry Research Group, Royal School of Mines, Imperial Coll., London SW7.
For primary bibliographic entry see Field 5B.
W87-09277

BASIC HYDRAULICS,
Royal Military Coll. of Science, Shrivenham (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W87-09304

MECHANICS OF SEDIMENT TRANSPORTATION AND ALLUVIAL STREAM PROBLEMS,
University of Roorkee (India).
For primary bibliographic entry see Field 2J.
W87-09337

DETERMINATION OF MAXIMUM DESIGN DISCHARGES,
F. V. Zalesskii, L. F. Sotnikova, E. F. Chekalovskii, and O. V. Pollskii.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 7, p 430-435, July 1986. 1 fig, 1 tab, 18 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 36-40, July 1986.

Descriptors: *Streamflow forecasting, *Mathematical studies, Discharge capacity, Probabilistic process, Prediction, Design discharge.

Many hydrologists estimate the maximum design discharge with the use of probability distribution curves bounded above, i. e., requiring calculation of the ultimate discharge. This paper reviews the accuracy of these predictions especially in the upper bounds. It is shown that extrapolation is unproved and imprudent, and it is recommended that more study is required for assigning design probability of discharges. (Ram-PTT)
W87-09362

LABORATORY AND INSTREAM NITRIFICATION RATES FOR SELECTED STREAMS,
Environmental Protection Agency, Athens, GA.
For primary bibliographic entry see Field 2H.
W87-09378

TURBULENCE STATISTICS IN FULLY DEVELOPED CHANNEL FLOW AT LOW REYNOLDS NUMBER,
NASA Ames Research Center, Moffett Field, CA 94035, USA.
For primary bibliographic entry see Field 8B.
W87-09383

OVERTOPPING RISK FOR AN EXISTING DAM,
Illinois Univ. at Urbana-Champaign.
For primary bibliographic entry see Field 8A.
W87-09461

WINTER FLOW, ICE, AND WEATHER CONDITIONS OF THE UPPER ST. LAWRENCE RIVER, 1971-81; VOLUME I: ICE COVER CHARTS (PART A),
Clarkson Coll. of Technology, Potsdam, NY.
H. T. Shen, G. C. Pasquarell, and R. W. Ruggles.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-166256, A12 in paper copy, A01 in microfiche. Report No. 82-1, June 1982. 248 p, 243 charts. Contract No. NA80RAC00147.

Descriptors: *Rivers, *Ice cover, St. Lawrence River.

Ice cover charts are presented for the St. Lawrence River for ten winters between December 1, 1971 and April 30, 1981. These charts were prepared from ice cover mosaics made from aerial photographs. The following types of ice or water were symbolized: open water, open water or polynaya, solid ice cover, solid ice cover with some open-water areas, consolidating/melting ice cover, consolidating/melting ice cover with some open-water areas, and ice floes or frazil slush and pans. The number of dates charted for each winter are on the order of 10 to 20. (Cassar-PTT)
W87-09475

DEVELOPMENTS IN LARM2: A LONGITUDINAL-VERTICAL, TIME-VARYING HYDRODYNAMIC RESERVOIR MODEL,
Edinger (J.E.) Associates, Inc., Wayne, PA.
For primary bibliographic entry see Field 8B.
W87-09489

2F. Groundwater

ESTIMATION OF GROUNDWATER RECHARGE IN SANDY TILL WITH TWO DIFFERENT METHODS USING GROUNDWATER LEVEL FLUCTUATIONS,
P.-O. Johansson.
Journal of Hydrology JHYDA7, Vol. 90, No. 3/4, p 183-198, April 1987. 12 fig, 3 tab, 34 ref.

Descriptors: *Recharge, *Groundwater recharge, *Water level fluctuations, *Moraine, *Sweden, *Model studies, *Soil water, *Water yield, Precipitation, Snow, Interception, Evapotranspiration, Simulation.

Two methods for estimation of groundwater recharge, both based on groundwater level fluctuations, were applied in a moraine area in southeastern Sweden. The first method utilized a one-dimensional soil water model which was tested against observed groundwater levels. The boundary conditions were defined by using standard meteorological data and submodels for precipitation, snow dynamics, interception, evapotranspiration and horizontal groundwater outflow. The second method directly transformed groundwater level fluctuations to equivalent amounts of water from a constructed recession curve and the specific yield concept. Conceptually the two methods could be characterized as inflow and response methods respectively. A good fit between observed and simulated groundwater levels was obtained by the soil water modelling. The results were, however, shown to be rather insensitive to displacement in the water balance between evapotranspiration and groundwater outflow, giving a good fit for a simulated net groundwater recharge ranging between 134 and 197 mm. The results from the attempts to use groundwater level fluctuations directly were discouraging. Compared to the soil water simulations the results were unstable and quite different for different years. It was impossible to use a constant specific yield or even different specific yields depending on depth. The conclusion was that the possibilities to use groundwater level data for quantitative water balance studies are limited under the studied climatical and hydrogeological conditions. The modelling effort clearly demonstrated the need for a better quantitative knowledge on soil properties if water balance information is to be deduced. The soil water model though, could be a valuable tool studying variations within and between different years as well as processes and single events. (Author's abstract)
W87-08615

DETERMINATION OF HYDRAULIC CONDUCTIVITY FROM AUGER HOLES AND PITS - AN APPROXIMATION,
D. O. Lomen, A. W. Warrick, and R. Zhang.
Journal of Hydrology JHYDA7, Vol. 90, No. 3/4, p 219-229, April 1987. 3 fig, 1 tab, 9 ref, append.

Descriptors: *Hydraulic conductivity, *Saturated flow, *Groundwater movement, *Test holes, *Auger holes, *Steady state, Pits, Numerical analysis, Saturation, Permeability coefficient.

A steady-state solution is developed which relates saturated hydraulic conductivity to rate of rise in auger holes and pits of arbitrary geometries. The analysis assumes axial symmetric cavities and steady-state conditions and uses the solution for a disc source in infinite space together with the method of images. Numerical results and a table are presented for 'arc' and 'trapezoidal' shaped pits. (Author's abstract)
W87-08617

UNSTEADY FLOW TO WELLS IN LAYERED AND FISSURED AQUIFER SYSTEMS,
Free Univ., Amsterdam (Netherlands). Inst. of Earth Sciences.
C. J. Hemker, and C. Maas.
Journal of Hydrology JHYDA7, Vol. 90, No. 3/4, p 231-249, April 1987. 5 fig, 3 tab, 25 ref, 2 append.

Descriptors: *Model studies, *Unsteady flow, *Wells, *Fissured aquifers, *Drawdown, *Data interpretation, *Groundwater movement, Algorithms, Least squares method, Flow, Aquifers.

A solution has been developed for the calculation of drawdowns in leaky and confined multi-aquifer systems, pumped by a well of constant discharge penetrating one or more of the aquifers. In contrast to earlier solutions the effects of elastic storage in separating and bounding aquitards have now completely been accounted for. The computing technique is based on the numerical inversion of the Laplace transform. Two different methods are used and results are compared with an analytical solution. Both Stehfest's algorithm and Schapery's least squares method yield accurate results in a fraction of the computation time required for the analytical evaluation. Selected sets of time-drawdown and distance-drawdown curves are plotted to illustrate multiple-aquifer well flow and to compare new solutions with results which were previously published. The analogy with flow is unconfined and fissured aquifers is demonstrated by multilayer models, representing multiple-porosity formations with linear and diffusive crossflow. (Author's abstract)

W87-08618

FINITE ELEMENT ANALYSIS OF WATER FLOW IN VARIABLY SATURATED SOIL,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W87-08620

INTRODUCTION TO GROUNDWATER MODELING; FINITE DIFFERENCE AND FINITE ELEMENT METHODS,
Wisconsin Univ.-Madison.
H. F. Wang, and M. P. Anderson.
W. H. Freeman and Co., San Francisco, CA. 1982. 237 p.

Descriptors: *Groundwater movement, *Model studies, *Finite element method, Computer programs, Flow profiles, Flow rates, Computers, Path of pollutants.

A fundamental and practical introduction to groundwater modeling by finite difference and finite element techniques has the aim of conveying a full understanding of the steps leading to the short sample computer programs that are included. The programs can be run on any computer with a FORTRAN compiler. In Chapter 1, some fundamental principles of groundwater flow are reviewed. In Chapters 2 and 3, an introduction to the finite difference method as applied to steady-state problems is presented. The method is to present selected applications for which numerical solutions are compared with analytical solutions. This method is used to verify the accuracy of the numerical solution. In Chapters 4 and 5, the method of finite differences is applied to transient flow problems. Governing equations used in Chapters 1 through 5 are derived as needed. Chapters 6 and 7 contain an introduction to the method of finite elements as applied to steady-state and transient flow problems, respectively. Finally, Chapter 8 contains a discussion of contaminant transport. The advection-dispersion equation is derived, which governs the movement of contaminants through a groundwater system; the finite element method is used to solve a sample problem. (Lantz-PTT)
W87-08684

GROUNDWATER ENGINEERING,
A.-A. I. Kashef.
McGraw-Hill Book Co., New York, NY. 1986. 512 p.

Descriptors: *Groundwater, *Geohydrology, *Groundwater movement, Flow systems, Aquifers, Wells, Saline water intrusion, Groundwater availability, Groundwater management, Seepage, Mathematical studies, Subsidence.

This book discusses the field of groundwater engineering with a minimal amount of mathematics in a simple and clear manner, emphasizing the techniques of quantitative evaluations of groundwater flow, seepage through and around dams, water wells, saltwater intrusion, and groundwater management. The book is divided into nine chapters. The first two chapters are devoted to a review of the basic fundamentals of groundwater occurrence and the properties of flow media. A discussion of groundwater quality is also included in these chapters. Chapter 3 explains the fundamentals of groundwater flow. The history of groundwater engineering is discussed in Chapter 4. Recent advances in groundwater engineering and a listing of sources of pertinent data and literature references are also included in Chapter 4. Two-dimensional flow systems are explained in Chapter 5, with emphasis on flow nets, seepage through earth dams (including new, simple approaches), and hydraulic design of solid dams or weirs. Chapter 6 discusses the various means of determining the hydrologic parameters of aquifers (other than by well pumping, which is presented in detail in Chapter 8). The environmental effects on these parameters as well as their inclusion in the hydrodynamic equations are also explained in Chapter 6. The main elements of groundwater management are briefly discussed in Chapter 7, supplemented by a relatively long list of references. Water-well hydraulics is discussed in detail in Chapter 8. The available techniques used in water wells are explained, and new techniques are introduced for overpumped artesian wells and gravity wells. Chapter 8 also includes a special section on land subsidence due to well pumping. Chapter 9 is devoted to an analysis of saltwater intrusion. (Lantz-PTT)
W87-08687

GEOCHEMISTRY, SOILS AND CARDIOVASCULAR DISEASES,
World Health Organization, Geneva (Switzerland). Div. of Noncommunicable Diseases.
R. Masironi.
Experientia EXPEAM, Vol. 43, No. 1, p 68-74, January 1987. 6 fig, 4 tab, 25 ref.

Descriptors: *Geochemistry, *Drinking water, *Mineralization, *Water quality effect, *Cardiovascular diseases, *Trace elements, *Hardness, *Selenium, Groundwater.

The hypothesis is presented that deficiencies or excesses in the content or availability of trace elements in rocks and soils, or in water flowing through them, may be a possible cause of certain chronic diseases including cardiovascular ones. The geographic distribution of cardiovascular diseases is often associated with geochemical differences. This trend is particularly evident in the United States and in Europe, with higher rates for cardiovascular mortality in areas underlain by soils that are poor in most essential trace elements. Configuration of this trend is found in connection with the degree of mineralization of local water supplies. Areas that are served by soft waters usually show higher rates of cardiovascular mortality and other forms of cardiovascular pathology, compared with the areas that are served by hard waters. Such a negative association between water hardness and cardiovascular pathology is evident in many countries, both industrialized and developing ones. (Author's abstract)
W87-08692

GROUNDWATER RECHARGE AND DISCHARGE RESPONSE TO RAINFALL ON A HILLSLOPE,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
T. Talsma, and E. A. Gardner.
Australian Journal of Soil Research ASORAB, Vol. 24, No. 3, p 343-356, 1986. 9 fig, 3 tab, 16 ref.

Descriptors: *Rainfall-runoff relationships, *Infiltration, *Runoff, *Groundwater recharge, *Catchment areas, *Water table, *Rainfall, Forests, Slopes, Hydraulic conductivity, Soil water.

Groundwater recharge was investigated within a representative hillslope segment of a small forested catchment, where the depth to the water table increased when progressing upslope from a free water outlet. Catchment soils varied with progression upslope from grey through yellow to red earths, which were underlain by low hydraulic conductivity B horizons and permeable substrata. The catchment was equipped for measuring stream discharge, rainfall characteristics, water table position, soil water content and soil hydraulic properties. Measurements commenced when soil water was severely depleted by drought, and were continued to monitor infiltration and redistribution with depth after more than 1000 mm of rainfall. Water movement occurred under approximately unit hydraulic gradients to the layer of restricted hydraulic conductivity; with movement through this layer proceeding under gradients considerably in excess of unity. Between rainfall events water movement in the soil profiles with deep water tables occurred by redistribution, with the capillary flux exceeding the gravitational flux. Where water tables were shallow (< 4 m), profile recharge occurred within 7 weeks, after which sustained recharge to the groundwater body occurred at rates of the order of 3 mm/day. Where water tables were deep (> 7 m) it took many months for the soil water deficit to be replenished by rainfall. Recharge to groundwater in this case commenced with a flux of about 0.5 mm/day and decreased to an estimated value of 0.3 mm/day some 5 months later. Following winter rain more than 30% of the annual groundwater discharge from the catchment originated from a relatively small but expanding area near the free water outlet. (Author's abstract)
W87-08706

REVERSE PATHLINE CALCULATION OF TIME-RELATED CAPTURE ZONES IN NONUNIFORM FLOW,
Illinois State Water Survey, Champaign. Ground-Water Section.
J. M. Shafer.
Ground Water GRWAAP, Vol. 25, No. 3, p 283-289, May-June 1987. 9 fig, 11 ref.

Descriptors: *Unsteady flow, *Capture zone, *Numerical analysis, *Wells, *Groundwater movement, *Flow, Aquifers, Anisotropy.

A simple to understand and easy to implement numerical technique, based on reverse calculation of groundwater flow paths, is applied to delineation of time-related capture zones around water-supply wells. The areal extent of a t-year capture zone in a two-dimensional regional flow domain is approximated by a large set of reverse pathlines all with t-year travel times. The numerical approach is suitable for calculation of time-related capture zones in steady, nonuniform flow with inhomogeneous, anisotropic aquifer conditions. The example applications show the sensitivity of this technique to the influence of multiple wells in a block inhomogeneous flow regime. (Author's abstract)
W87-08753

DIFFUSIVITY OF A GLACIAL-OUTWASH AQUIFER BY THE FLOODWAVE-RESPONSE TECHNIQUE,
Geological Survey, Albany, NY. Water Resources Div.
R. J. Reynolds.
Ground Water GRWAAP, Vol. 25, No. 3, p 290-299, May-June 1987. 5 fig, 2 tab, 12 ref.

Descriptors: *Surface-groundwater relations, *Groundwater movement, *Aquifer diffusivity, *Floodwave response, *Water level fluctuations, *Model studies, Aquifers, Streams, Water storage.

Aquifer diffusivity (transmissivity divided by storage coefficient) was calculated for three sites in a glacial-outwash valley aquifer near Cortland, New York from water-level fluctuations induced by rises in stream stage. The observed response data were analyzed through use of a one-dimensional floodwave-response model to calculate the theoretical head response in the aquifer generated by a floodwave in the stream, and then matched to the observed head response. Diffusivity values computed from sharply peaked flood rises ranged from 6.08 to 8.68 sq ft. The closest match between observed and calculated heads was obtained from a site where the aquifer is confined and the saturated thickness (and thus the diffusivity) remains constant with the passage of a floodwave. Arrival time of the observed floodpeak seems to be the most useful criterion for curve matching, especially under unconfined conditions, where a match to the rising limb and floodpeak is difficult because of changes in the saturated thickness. A transmissivity value of 14,700 sq ft/d for the glacial-outwash aquifer, calculated from specific capacity data from a nearby industrial well, combined with diffusivity calculated by the floodwave-response method, indicates a storage coefficient between the normal ranges for unconfined and confined aquifers. Calculated storage coefficients were 0.015, 0.027, and 0.034 at the three sites. The floodwave-response method of calculating aquifer diffusivity is relatively inexpensive compared to standard aquifer tests and is effective in glacial-valley fill aquifers that are hydraulically connected to a major stream or river. (Author's abstract)
W87-08754

MONITORING WELL INSTALLATION, PURGING, AND SAMPLING TECHNIQUES - PART 1: CONCEPTUALIZATIONS,

Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 7B.
W87-08755

ALTERNATE PROCEDURE FOR ANALYZING AQUIFER TESTS USING THE THEIS NONEQUILIBRIUM SOLUTION,
City Coll., New York. Dept. of Earth and Planetary Sciences.
For primary bibliographic entry see Field 7C.
W87-08756

COMPARISON OF FIELD AND LABORATORY METHODS FOR DETERMINING CONTAMINANT FLOW PARAMETERS,
Toronto Univ., Scarborough (Ontario). Groundwater Research Group.
For primary bibliographic entry see Field 5B.
W87-08757

IMPACT OF THE DUPUIT-FORCHHEIMER APPROXIMATION ON SALT-WATER INTRUSION SIMULATION,
Kansas State Geological Survey, Lawrence.
M. Kemblowski.
Ground Water GRWAAP, Vol. 25, No. 3, p 331-336, May-June 1987. 9 fig, 5 ref. BuRec Grant 4-FG-93-00080.

Descriptors: *Groundwater movement, *Model studies, *Saline-freshwater interfaces, *Numerical analysis, *Data interpretation, *Saline water intrusion, *Simulation, *Dupuit-Forchheimer approximation, Sinks, Drains.

Numerical analysis based on the finite-difference and boundary element methods is used to investigate the impact of the Dupuit-Forchheimer approximation on results of salt-water intrusion simulation. It is found that for sinks or sources (drain, ditch) that are small compared to the freshwater-zone thickness, the use of the Dupuit-Forchheimer approximation may cause substantial errors. For such cases, a correction method is proposed and verified. (Author's abstract)
W87-08758

PERFORMANCE AND ANALYSIS OF AQUIFER TRACER TESTS WITH IMPLICATIONS FOR CONTAMINANT TRANSPORT MODELING - A PROJECT SUMMARY,
Auburn Univ., AL. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-08759

PREDICTIVE APPLICATION OF AN ORNL GEOHYDROLOGY MODEL,
Miami Univ., FL. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 7C.
W87-08760

GEOLOGIC ISOLATION OF HIGH-LEVEL RADIOACTIVE WASTE: PUTTING IT AWAY FOREVER,
For primary bibliographic entry see Field 5E.
W87-08805

PROFILES OF NITROGEN SPECIES IN A SAND-SILT AQUIFER AT HASLEMOEN, SOLOR, SOUTH NORWAY,
Agricultural Univ. of Norway, Aas.
For primary bibliographic entry see Field 5B.
W87-08818

LABORATORY EXPERIMENTS ON SOLUTE TRANSPORT IN NON-HOMOGENEOUS POROUS MEDIA,
Technical Univ. of Denmark, Lyngby.
For primary bibliographic entry see Field 5B.
W87-08819

STOCHASTIC MODELLING OF A CONTAMINATED AQUIFER: THE UNCONDITIONAL APPROACH,
Technical Univ. of Denmark, Lyngby.
For primary bibliographic entry see Field 5B.
W87-08820

MODELLING WATER EXCHANGE AND TRANSIT TIMES IN TILL BASINS USING OXYGEN-18,
Sveriges Meteorologiska och Hydrologiska Inst., Norrkoeping.
For primary bibliographic entry see Field 2A.
W87-08821

GROUNDWATER MODELLING FOR HYDROPOWER DEVELOPMENT IN ICELAND,
VST Consulting Engineers, Reykjavik (Iceland).
S. Freysteinsson, and S. Helgason.
Nordic Hydrology NOHYBB, Vol. 17, No. 4/5, p 407-416, 1986. 4 fig, 13 ref.

Descriptors: *Groundwater movement, *Groundwater, *Model studies, *Hydraulic structures, *Hydroelectric power, *Dams, *Reservoirs, Crystalline rocks, Lava, Rocks, Iceland, Hydraulic design, Performance evaluation, Leakage, Water loss, Seepage, Comparison studies.

Groundwater problems in moberg and lava formations are frequently encountered in connection with development of hydroelectric power resources in the volcanic zones in Iceland. An account of the design work and an evaluation of performance related to groundwater and seepage at some of Landsvirkjun's projects in Southwest Iceland are presented. The major problems encountered are: leakage under dams on lava, seepage from reservoirs on lava and moberg formations, seepage from canals and dewatering of excavations. The most relevant problems are associated with dams founded on lava and seepage from reservoirs on lava. The discussion concentrates on three such dams, at Thorisos, Hrauneyjafoss and Sultartangi. The methods used for estimating seepage were described briefly and forecasts and observations after construction were compared. In general, the reservoirs and structures have performed satisfactorily. (Author's abstract)
W87-08829

HYDROLOGY, WATER CHEMISTRY AND ECOLOGICAL RELATIONS IN THE RAISED MOUND OF COWLES BOG,
National Park Service, Porter, IN. Indiana Dunes National Lakeshore.
For primary bibliographic entry see Field 2H.
W87-08837

TREES AS INDICATORS OF SUBTERRANEAN WATER FLOW FROM A RETIRED RADIOACTIVE WASTE DISPOSAL SITE,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5A.
W87-08845

GROWTH OF MIXED MICROBIAL POPULATIONS IN GROUND WATER CONTAINING HIGHLY CHLORINATED ORGANIC WASTES,
Louisiana State Univ. Medical Center, New Orleans. Dept. of Microbiology, Immunology, and Parasitology.
For primary bibliographic entry see Field 5B.
W87-08878

ASSOCIATION BETWEEN LEGIONELLA PNEUMOPHILA AND AMOEBAE IN WATER,
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
For primary bibliographic entry see Field 5F.
W87-08906

WATER QUALITY BENEATH URBAN RUNOFF WATER MANAGEMENT BASINS,
Agricultural Research Service, Fresno, CA. Water Management Research Lab.
H. I. Nightingale.
Water Resources Bulletin WARBAQ, Vol. 23, No. 2, p 197-205, April 1987. 10 tab, 13 ref. ARS Cooperative agreement SEA C/A 12-14-5001-750.

Descriptors: *Water pollution sources, *Runoff, *Water quality, *Basins, *Water management, *California, *Soil water, *Groundwater, Pollutants, Percolation, Monitoring, Pesticides.

The chemical impact of urban runoff water on water quality beneath five retention/recharge basins was investigated as part of the US EPA's Nationwide Urban Runoff Program in Fresno, California. Soil water percolating through alluvium soils and the groundwater at the top of the water table were sampled with ceramic/Teflon vacuum water extractors at depths up to 26 m during the two-year investigation. Inorganic and organic pollutants are present in the runoff water delivered to the basins. No significant contamination of percolating soil water or groundwater underlying any of the five retention/recharge basins has occurred for constituents monitored in the study. The oldest basins was constructed in 1962. The concentration of selected trace elements in the regional groundwater. None of the pesticides or other organic priority pollutants, for which water samples were analyzed, was detected except diazinon which was found in trace amounts (0.3 microgram/L or less) in only three soil water samples. These results are important to the continued conservation of storm water and the development of a best management practice for storm-water management using retention/recharge basins in a semi-arid climate. (Author's abstract)
W87-08967

STEADY-STATE ANALYSIS OF INFILTRATION AND OVERLAND FLOW FOR SPATIALLY-VARIED HILLSLOPES,
Utah State Univ., Logan. Dept. of Forest Resources.
For primary bibliographic entry see Field 2E.
W87-08974

ARTIFICIAL GROUND WATER RECHARGE BY FLOODING DURING GRAPEVINE DORMANCY,
Univ. of California, Davis. Dept. of Viticulture and Enology.
N. K. Dokoozlian, V. E. Petrucci, J. E. Ayars, C. D. Clary, and R. A. Schoneman.
Water Resources Bulletin WARBAQ, Vol. 23, No. 2, p 307-311, April 1987. 2 fig, 4 tab, 6 ref.

Descriptors: *Artificial recharge, *Groundwater recharge, *Flooding, *Grapevines, California, San Joaquin Valley, Irrigation, Clay, Loam, Food crops, Crop yield.

The potential for artificial groundwater recharge by continuous flooding of dormant grapevines was evaluated in the San Joaquin Valley of California using the cultivar Thompson Seedless. The study was started in 1982 and was completed in 1985 after three complete flooding cycles during dormancy. An average daily rate of recharge of 80 mm/day for a 32-day period each year was achieved through a clay loam soil. There were no adverse effects on the grapevines and yields in the flooded plots in any of the growing seasons following recharge periods. Yields were higher in the recharge plots than in the control plots in the last year of the study. We conclude that artificial groundwater recharge by continuous flooding during grapevine dormancy is a viable recharge method. (Author's abstract)
W87-08979

VELOCITY CONTROL AS A TOOL FOR OPTIMAL PLUME CONTAINMENT IN THE EQUUS BEDS AQUIFER, KANSAS,
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 5G.
W87-08982

CAPILLARITY CORRECTION FOR FREE SURFACE FLOW OF GROUNDWATER,

New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
J.-Y. Parlange, and W. Brutsaert.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 805-808, May 1987. 2 fig, 1 tab, 18 ref.

Descriptors: *Groundwater movement, *Capillarity effects, *Mathematical equations, *Boussinesq equation, *Data interpretation, Drawdown, Aquifers, Equations, Performance evaluation.

The Boussinesq equation describes aquifer movement when capillarity effects are unimportant. A simple correction term to the equation is proposed here to take those effects into account. The correction can be quite significant for relatively short times. Comparison with experimental observations for a sudden drawdown shows that the present theory greatly improves the Boussinesq equation. (Author's abstract)
W87-09018

STATISTICAL STRUCTURE AND FILTER CHARACTERISTICS OF TRITIUM FLUCTUATIONS IN FRACTURED BASALT,
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W87-09027

SIMULATION OF THE BORDEN PLUME USING THE ALTERNATING DIRECTION GALERKIN TECHNIQUE,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W87-09030

HUMIC SUBSTANCES IN GROUNDWATER,
Geological Survey, Denver, CO. Water Resources Div.
E. M. Thurman.
IN: Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization. John Wiley and Sons, New York, NY. 1985. p 87-103, 2 fig, 9 tab.

Descriptors: *Humic substances, *Groundwater, *Chemical analysis, *Aquifers, *Florida, *Colorado, *Minnesota, *South Dakota, Dissolved solids, Organic carbon, Interstitial water, Organic matter, Kerogen.

Organic carbon and humic substances in groundwater and the characterization and origin of humic substances in groundwater are discussed and reviewed. Because the concentration of organic carbon in groundwater is commonly less than 1 mg carbon/L, it is difficult to isolate and characterize humic substances, and there are relatively few studies of these substances in groundwater. One major study is reviewed in detail. In this study, humic substances from the water in five aquifers were isolated by sorption onto macroporous resins. The samples came from the following aquifers: Biscayne (Florida), Laramie-Fox Hills (Colorado), St. Peters (Minnesota), and Madison and Red River (South Dakota). The concentration of humic substances in groundwater increased with the concentration of dissolved organic carbon (DOC) from 0.04 mg C/L (21% of DOC of St. Peters) to 8.6 mg C/L (66% of DOC of Biscayne). Humic substances from groundwater have less oxygen and less color than humic substances from surface water. They are similar to humic substances in surface waters in binding constants for copper (log K = 5.6 at pH 6.4). Based on these characterizations, humic substances in groundwater may originate either from humic substances in soil interstitial waters, or from kerogen, the organic matter deposited with the sediments of the aquifer. (See also W87-09067) (Author's abstract)
W87-09070

GROUNDWATER-LEACHATE: MODELING/MONITORING/SAMPLING,
New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W87-09089

GROUND WATER POLLUTION CONTROL,
Oklahoma Univ., Norman. Environmental and Ground Water Inst.
For primary bibliographic entry see Field 5G.
W87-09150

HYDROGEOLOGICAL ASPECTS OF AGRICULTURAL DRAINAGE IN IRELAND,
Minerex Ltd., Dun Laoghaire (Ireland).
For primary bibliographic entry see Field 2E.
W87-09203

GROUNDWATER MANAGEMENT IN FRANCE,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
J. Margat.
Environmental Geology and Water Sciences EGWSEI, Vol. 9, No. 2, p 105-108, 1987.

Descriptors: *Groundwater management, *France, *Planning, *Public policy, *Legal aspects, *Reviews, *Social aspects, *Economic aspects, Water management, Groundwater, Groundwater potential, Water use, Water quality, Water quality management, Irrigation, Wells, Financing, Decision making, Forecasting, Model studies, Aquifers.

Groundwater must be managed so as to reconcile this unique resource with its many users, and its long-term preservation with short-term utilization requirements. Under the natural, legal, and economic conditions prevailing in France, where groundwater constitutes a large part of water production and resources, and where there are tens of thousands of economic developers and users of a few hundred natural groundwater management units, such management concerns these users as well as the public and collective authorities that control the users' activities for the common present and future good of all. Legislative, financial, and educational means are applied simultaneously to preserve and protect the quality and quantity of the groundwater and at times to encourage its use and stimulate its development. (Author's abstract)
W87-09205

IRRIGATED AGRICULTURE AND GROUNDWATER QUALITY--A FRAMEWORK FOR POLICY DEVELOPMENT,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6A.
W87-09212

NONPOINT AGRICULTURAL POLLUTION: PESTICIDE CONTAMINATION OF GROUNDWATER SUPPLIES,
Rhode Island Univ., Kingston. Dept. of Resource Economics.
For primary bibliographic entry see Field 5B.
W87-09213

SUBGLACIAL DRAINAGE FOR AN ICE SHEET RESTING UPON A LAYERED DEFORMABLE BED,
Faculty of Science, Simon Fraser Univ., British Columbia, Canada.
E. M. Shoemaker, and H. K. N. Leung.
Journal of Geophysical Research (B) JJGBDU, Vol. 92, No. 6, p 4935-4946, May 1987. 3 fig, 7 tab, 18 ref.

Descriptors: *Glaciers, *Glaciohydrology, *Model studies, *Subglacial drainage, *Ice sheets, *Hydrology, *Aquifers, *Groundwater, Hydraulic conductivity, Aquitards, Meltwater, Channels, Overburden, Prediction, Ice.

The subglacial hydrology is considered for a temperate ice sheet resting upon a deformable aquitard (till) with a hydraulic conductivity several orders of magnitude lower than that of an underlying aquifer. The evacuation of basal meltwater by the aquifer-channel-bed hydraulic system is studied, particularly as it affects aquifer pressurization, till deformation, and channel failure. Sensitive parameters are aquifer hydraulic conductivity, ice sheet length and elevation, and basal meltwater rate. A criterion is developed to determine channel length; channels need not extend all the way to the divide. The model predicts that, in general, there is a region adjoining the terminus where the bed pore water pressure is equal to the overburden pressure and drainage along the bed is possible. Outside this region the bed pore water pressure is below the overburden pressure, and ice penetrates the soil to prevent drainage along the bed. An important result is that deformable substrates beneath temperate-based ice sheets may be unstable, particularly under conditions of a diminishing profile. (Author's abstract)
W87-09248

BASIC HYDRAULICS,
Royal Military Coll. of Science, Shrivenham (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W87-09304

GROUNDWATER TRANSPORT: HANDBOOK OF MATHEMATICAL MODELS,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5B.
W87-09306

ORIGIN OF BRINE IN THE SAN ANDRES FORMATION, EVAPORITE CONFINING SYSTEM, TEXAS PANHANDLE AND EASTERN NEW MEXICO,
Texas Univ. at Austin. Bureau of Economic Geology.
A. R. Dutton.
Geological Society of American Bulletin BUGMA, Vol. 99, No. 1, p 103-112, July 1987. 8 fig, 3 tab, 47 ref.

Descriptors: *Groundwater origins, *Groundwater movement, *Brines, *Chemical reactions, Connate water, Meteoric water, Carbonate rocks, Aquifers, Geohydrology, Texas, Fracture permeability, Aquicludes.

Possible origins of calcium-chloride and sodium chloride brines that occur in the low-permeability San Andres carbonate rock are examined. Chemical analyses of 50 samples of potable groundwater and of 161 samples of saline water form oil field sin the San Andreas Formation were compiled from published reports and commercial surveys. Oxygen and deuterium isotopic compositions of San Andres brine in the Palo Duro Basin differ from those of meteoric water in precipitation and near-surface aquifers throughout the study area. The chemical and isotopic composition of brine from a carbonate bed in the Permian San Andres Formation suggests that post-Permian groundwater movement within the evaporite section has been negligible. Similarity between delta deuterium and delta 180 of brine in San Andres carbonate rock and delta deuterium and delta 180 of Permian fluid inclusions in halite beds implies that brine in the carbonate rock is connate and originated as Permian evaporatively concentrated sea water. Extensive rock-water reactions that account for chemical and isotopic composition of the brine by circulating meteoric groundwater seem more complex and less substantiated than does diagenetic change of connate Permian brine. Small Na/Cl ratios suggest that ion exchange removed sodium from connate brine and allowed solution of halite in the subsurface, increasing chloride concentration to 250,000 mg/L. Rate, distribution, and duration of groundwater flow has determined the present proportion of connate brine and meteoric water in the evaporite confining system. Groundwater in the low permeability San Andres carbonates in the Palo Duro Basin can be dominated by connate brine if potential for groundwater flow across the evaporite confining system has existed for only the past several million years and if marked permeability contrasts within San Andres carbonates limit intrastratal recharge. The geologically slow re-

sponse of water composition to a presumed change in hydrogeologic setting implies that the evaporite confining system might be regarded as a regional aquiclude. (Peters-PTT)
W87-09351

MAINTENANCE AND STABILITY OF INTRODUCED GENOTYPES IN GROUNDWATER AQUIFER MATERIAL,
Tennessee Univ., Knoxville. Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W87-09391

DISTRIBUTION OF PROTOZOA IN SUBSURFACE SEDIMENTS OF A PRISTINE GROUNDWATER STUDY SITE IN OKLAHOMA,
Dept. of Microbiology, Cornell Univ., Ithaca, NY 14853.
For primary bibliographic entry see Field 2H.
W87-09395

EXTREME FLOODS IN SOUTHERN AFRICA CAUSED BY TROPICAL CYCLONE DOMOINA,
Department of Water Affairs, Forestry and Environmental Conservation, Pretoria (South Africa).
Z. Kovacs, and D. B. du Plessis.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 5, p 33-37, May 1987. 3 fig, 7 tab, 6 ref.

Descriptors: *Floods, *Cyclone Domoina, *Africa, *Tropical storms, Indian Ocean, Weather, Mozambique, Swaziland, South Africa, Storms, Rainfall, Rivers, Reservoirs.

On 29 January 1984, the tropical cyclone Domoina moved over Southern Africa from the Indian Ocean and caused the largest ever floods in parts of Southern Mozambique, Swaziland and South Africa. The article describes those prominent features of the extreme flood which are instructive for water engineers. (Author's abstract)
W87-09410

SEASONAL EFFECTS ON GROUND-WATER CHEMISTRY OF THE OUACHITA MOUNTAINS,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 2K.
W87-09428

LLNL GROUNDWATER QUALITY: SAMPLING OF SEVEN SHALLOW WELLS ON THE LLNL SITE,
Lawrence Livermore National Lab., CA.
For primary bibliographic entry see Field 5B.
W87-09458

INFLUENCE OF MELTWATER ON THE AMOUNT AND COMPOSITION OF GROUNDWATER IN QUATERNARY DEPOSITS IN FINLAND,
National Board of Waters, Helsinki (Finland).
J. Soveri.
Publication No. 63, 1985. 92 p, 49 fig, 42 tab, 135 ref.

Descriptors: *Water quality, *Acidity, *Snowmelt, *Groundwater pollution, *Groundwater mining, *Acid rain, Bedrock, Groundwater, Aquifers, Groundwater availability, Water analysis, Ions, Cations, Anions, Percolation, Infiltration, Hydrogen ion concentration, Soil types, Regression analysis, Air pollution, Snow, Snow sampling.

The effects of meltwater on the quantity and quality of groundwater were studied by examining input-output balances in the saturated and unsaturated zones of different soils in the groundwater observation stations operated by the National Board of Waters. The comparison and interdependences of substance concentrations were studied using regression analyses and other statistical methods. The cause-effect relationship between variations in groundwater quantity and quality were studied using temporal series of observations in different groundwater formation regimes. Changes occurring in meltwater during infiltration, as well as the effects of meltwater quality on groundwater acidification, were estimated in shallow aquifers. The effect of atmospheric impurities on groundwater quality was greatest in regions with coarse-grained soil. Statistically significant differences in groundwater substance concentrations were recorded between the different bedrock groups. The ionic sums of cations and anions increased with increase in the fine-grained nature of the soil. The relationships between individual ions did not however differ radically in the different soil types. Since the buffering capacity of groundwater in Finland is low, shallow lying groundwater supplies are particularly sensitive to the effects of acidification. Integrated basic research has also been conducted at the stations to assist in groundwater acquisition. (Geiger-PTT)
W87-09460

WATER IN MINING AND UNDERGROUND WORKS (EL AGUA EN LA MINERIA Y TRABAJOS SUBTERRANEOS), VOLUMES I AND II.
Asociacion Nacional de Ingenieros de Minas, Consejo Superior de Colegios de Ingenioeros de Minas, Granada (Spain).
1984. SIAMOS 78. 1,353 p. Edited by R. Fernandez-Rubio.

Descriptors: *SIAMOS, *Mining engineering, *Mine drainage, *Mine wastes, *Groundwater pollution, *Acid mine drainage, Strip mine wastes, Mathematical models, Coal mining, Coal mines, Aquifers, Hydraulic machinery, Hydraulic mining, Geohydrology, Excavation.

The symposium SIAMOS-78 considered water, mining, and underground works. Over 80 papers were selected from the literature on this subject from all over the world. The papers presented are organized into six groups, each of which has a dominant theme or topic. In the first group, papers refer to hydrogeological investigation within the general theme of the SIAMOS meeting. In the second section, all the texts make reference to mining works and the special techniques that have to be used in the presence of water. The third section groups together all those contributions that have to do with the role of water as it affects the geotechnical behavior of excavations. The fourth group of papers deals with the application of mathematical models in relation to the circulation of the water and its drainage. The fifth group has as its common factor the problems of the quality of the water wastes from mining works. The sixth and last section will discuss miscellaneous topics covered by the SIAMOS. (See W87-09569 thru W87-09609) and (W87-09868 thru W87-09909) (Geiger-PTT)
W87-09568

ROLE OF HYDROGEOLOGY IN COAL MINING NEAR CHANDRAPUR IN MAHARASHTRA, INDIA,
Central Ground Water Board, Maharashtra (India). Central Region.
P. C. Adyalkar, and K. R. Srinivasan.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 1-16, 4 fig, 2 tab, 6 ref.

Descriptors: *Coal mining, *India, *Geohydrology, *Test wells, *Mine drainage, Mining engineering, Pumping, Seepage, Groundwater movement, Aquifers, Coal mines, Groundwater recharge, Pump wells.

The Barakar Series of the Lower Gondwanas of the Central India are stratigraphically important for the occurrence of rich deposits of coal of economic significance. It is in this formation that the Coal India Ltd. plan to adopt the depillaring program in the advanced coal mines to achieve maximum production based on the cost-benefit ratio, where it may pose the problem of heavy seepage inside the coal mines. At their insistance, hydrogeological studies were undertaken by the Central Ground Water Board with the construction of Test Wellfield Area near the Mahakali Colliery of Chandrapur in India. This has brought to light the precise status of the groundwater regime of the overlying Kamthis and the Barakars, and established the basic aquifer parameters for quantification of seepage flows during the depillaring program. These studies are of great significance for planning and designing the pumping program to prevent sudden flooding in the coal mines. (See also W87-09568) (Author's abstract)
W87-09569

MINE DRAINAGE PROBLEMS IN INDIAN COALFIELDS, WITH SPECIAL REFERENCE TO THE PROBLEMS IN JHARIA COALFIELD,
Indian School of Mines, Bihar (India). Dept. of Mining Engineering.
For primary bibliographic entry see Field 4C.
W87-09571

INFLUENCE OF STRUCTURE ON UNDERGROUND WATER PREDICTION AND OCCURRENCE AT ROKANA MINE, KITWE, ZAMBIA,
Nchanga Consolidated Copper Mines Limited, Kitwe (Zambia). Geology Dept.
R. C. Black.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 45-59, 5 fig, 1 tab, 11 ref.

Descriptors: *Mining engineering, *Mine drainage, *Groundwater movement, *Dewatering, *Stratigraphy, *Hydrologic models, Geohydrology, Prediction, Paleohydrology, Water distribution, Project planning, Aquifers, Topography.

The mining method at Rokana Division necessitates hanging wall dewatering prior to mining. Prediction of water occurrence has previously used a model based on stratigraphic control. This model could not always account for various exceptions. Evidence from recent drilling indicates that below the zone of weathering structural features play an increasingly important role in water distribution. The influence of Basement palaeotopography on physical and chemical changes in the Katangan sediments is profound. Recognition of these controlling factors on water distribution currently leads to more cost effective dewatering of the mine. (Author's abstract) PTT)
W87-09572

HYDROGEOLOGY OF UNDERGROUND COAL MINES IN ILLINOIS,
Illinois State Geological Survey Div., Champaign.
K. Cartwright, and C. S. Hunt.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 61-83, 12 fig, 1 tab, 10 ref.

Descriptors: *Mining engineering, *Groundwater movement, *Coal mining, *Mine drainage, *Illinois, *Geohydrology, Coal mines, Dewatering, Pumping, Permeability coefficient, Pumpage, Aquifers.

The hydrogeologic problems related to physical changes resulting from coal mining in the Illinois Coal Basin are discussed. Illinois mines are generally dry, with notable exceptions, despite being located in water-saturated rocks well below the water table. Reported pumpages of water from the mines vary from occasional pumping of sumps to pumpage in excess of 5000 cubic meters per day. Most mines, however, report pumpages of less than 100 cubic meters per day. Some mines are reported to still be dry many years after being abandoned. These small volumes of water reported from the mines are directly related to the extremely low hydraulic conductivity of the rock associated with the coal. There are several hydrogeologic settings in which water may be a problem in a mine. The most common hydrogeologic setting in which large volumes of water may occur in a mine is the situation where the mine approaches a buried

distributary channel within the coal-bearing rocks. A number of major channels in the coal basin have been mapped such as the Walshville Channel which is associated with Herrin (No. 6) Coal. Ancient bedrock valleys that have been cut down into or near the coal seam prior to and during the Pleistocene glaciations, leaving a thin, unstable mine roof provide another setting which produces problems with large volumes of water in shallow mines. The third situation in which water occurs in a mine is when a thin blanket sandstone acts as a groundwater reservoir. In these mines, the volume of water in the sandstone is generally not great enough to cause severe mining problems but rather it becomes a nuisance, particularly where the mine floor is a thick, soft, fine clay. (See also W87-09568) (Geiger-PTT)
W87-09573

ATTEMPTS TO DETERMINE THE VIABILITY OF A DEEP EXCAVATION ON THE COAST OF THE VANDELLOS MASSIF (TARRAGONA, SPAIN) (ENSAYOS PARA DETERMINAR LA VIABILIDAD DE UNA EXCAVACION PROFUNDA EN EL LITORAL DEL MACIZO DE VANDELLOS (TARRAGONA, EXPANA)),
Curso Internacional de Hidrologia Subterranea y Comisaria de Aguas del Pirineo Oriental, Barcelona (Spain).
E. Custodio.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 85-109, 8 fig, 13 ref.

Descriptors: *Engineering geology, *Groundwater control, *Drainage engineering, *Pumping plants, *Nuclear powerplants, *Excavation, *Coastal engineering, Project planning, Radioactive tracers, Pumping, Permeability, Salinity, Seawater.

In order to build the sea water pumping station for the cooling of one of the units in the nuclear site of Vandellos, a 30 m diameter pit is needed, penetrating deeper than 10 m below sea level in a place near the coastal line. To adopt appropriate construction steps, specific pumping and radiotracer tests have been completed, and a mean value of 1000 m/day, with maximum values of 4000 m/day, has been obtained for the formation permeability. The preferential water flow zone has been identified following the observation points response, the salinity variations and the radiotracer tests. To drain the pit, a continuous pumping of about 30 cu m/sec is needed, and because this looks unfeasible, other construction techniques are needed. (See also W87-09568) (Author's abstract)
W87-09574

EXPLOITATION AND CONTROL OF KARST WATER IN COAL MEASURES,
China National Mining Committee, Peking (China).
C. Chih-Kuei, and C. Chang-Lin.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 111-124, 7 fig.

Descriptors: *Drainage engineering, *Karst hydrology, *Karst, *Coal mines, *China, *Mine drainage, *Mining engineering, Groundwater movement, Groundwater management, Coal mining, Hydrologic data collections, Geohydrology, Limestone, Water resources development, Tectonics, Project planning.

The occurrence of a very thick water-bearing Cambro-Ordovician limestone in Handan and Xingtai district, Hebei Province, China, has presented difficulties for coal and iron ore mining operations. Hydrogeological surveys were carried out over a four yr period to turn the potential water hazard to the benefit of the economy of North China where water shortage is a problem. Survey results show that the tectonic structures are closely associated with the main course of underground water flow. The district may be divided into four hydrogeological units, namely the Fengfeng Unit in the south, the Xingtai Unit in the center, the Lincheng Unit in the north and the She Hsien Unit in the west. Solution fissures are the predominant form in the karst. Measures adopted to control the karst water underground are to dam water to guard against flooding in the the upper reaches, to seal up leakage under the river bed to prevent water infiltration in the middle reaches, and to build water reservoirs for agricultural uses in the lower reaches. (See also W87-09568) (Geiger-PTT)
W87-09575

HYDROGEOLOGICAL PROBLEMS AFFECTING THE EXPLOITATION OF THE PEAT BOG AT PADUL (GRANAD, SPAIN). PRELIMINARY STUDY (PROBLEMAS HIDROGEOLOGICOS QUE AFECTAN A LA EXPLOTACION DE LA TURBERA DE PADUL (GRANAD, ESPANA). ESTUDIO PRELIMINAR),
Universidad de Granada (Spain). Dept. of Hydrogeology.
For primary bibliographic entry see Field 4A.
W87-09576

HYDROGEOLOGIC FACTORS THAT MAY AFFECT MINE DRAINAGE IN THE ANTHRACITE REGION OF PENNSYLVANIA, EASTERN UNITED STATES,
Geological Survey, Harrisburg, PA.
For primary bibliographic entry see Field 4C.
W87-09577

PROPOSED HYDROGEOLOGICAL MODEL FOR FUTURE LIGNITE MINING AND GROUNDWATER DRAINAGE IN THE HULA BASIN, NORTHERN ISRAEL,
Geological Survey of Israel, Jerusalem. Hydrogeological Div.
U. Kafri, and N. A. Agron.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 173-181, 3 fig, 6 ref.

Descriptors: *Mining engineering, *Hydrologic models, *Mine drainage, *Groundwater movement, *Project planning, Geohydrology, Aquifers, Model studies, Excavation, Karst, Karst hydrology, Groundwater recharge.

Low grade lignite deposits are found in the subsurface of the Hula Basin within the northern part of the Jordan Rift Valley in Israel. The basin is bounded by Mesozoic karstic formations in which a considerable recharge of groundwater occurs. The mineable lignite beds are found down to a depth of 160 m below the ground surface, interbedded with lacustrine marls and chalks. The groundwater flow converges from the margins towards the basin and finally drains to the south. The surrounding karstic aquifers are characterized by high hydrological coefficients and their natural annual yield is several tens of millions of cubic meters of water, whereas the core of the basin consists of practically impermeable chalk, marl and lignite which form an aquiclude. The convergent flow is, therefore, probably limited to the margins. An unmined envelope of impermeable material along the margins, wide enough to prevent any lateral drainage into the open pit should be left. Thus only small quantities of water will have to be locally drained. (See also W87-09568) (Author's abstract)
W87-09578

PRELIMINARY HYDROGEOLOGICAL STUDY OF THE REOCIN MINE (SANTANDER, SPAIN) (ESTUDIO HIDROGEOLOGICO PRELIMINAR DE LA MINA DE REOCIN (SANTANDER, ESPANA)),
C. F. Lopez Vera, M. R. Llamas Madurga, and A. Peon Pelaez.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 183-198, 8 fig, 1 tab, 9 ref.

Descriptors: *Groundwater movement, *Groundwater management, *Mine drainage, *Pumping, *Mining engineering, Geohydrology, Groundwater recharge, Pumpage, Aquifers, Aquitards, Drainage patterns, Infiltration.

Reocin mine is one of the most important zinc mines in Spain. The current underground exploitation is carried out from deep galleries situated 200 and 240 meters below mean sea level. The drainage of the mine requires a pumping rate of about 0.9 cubic meters per second and an annual energy consumption of about 35 million kwh. The drainage flow system has been deduced taking into account the available data (meteorologic, hydrologic, geologic, chemical, etc.). It has been estimated that: less than 10% of the pumpage proceeds from direct rain infiltration; some small fraction of the pumpage seems to flow from a deeper aquifer through a specific faulted zone; another small fraction might correspond to contributions from a nearby stream that is in hydraulic connection with the aquifer, although leakage through the overlying aquitard might also be relevant. (See also W87-09568) (Author's abstract)
W87-09579

APPLICATION OF ISOTOPE TECHNIQUES AND WELL LOGGIND IN INVESTIGATING GROUND WATER INFLUENCED BY MINING,
Charles Univ., Praha (Czechoslovakia). Faculty of Science.
S. Mares, and J. Silar.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 199-206, 2 fig, 8 ref.

Descriptors: *Tracers, *Isotopic tracers, *Well logs, *Mine drainage, *Confined aquifers, *Groundwater movement, *Radioactive tracers, *Logging, Pumping, Sandstones, Hydraulic gradient, Boreholes, Aquifers, Mining engineering.

In a confined aquifer of Cenomanian sandstones, groundwater is pumped from boreholes to decrease the discharge of water entering a mine in Northern Bohemia. Another aquifer of Turonian sandstone is separated from the lower one by impermeable marlstone. Radiocarbon and tritium measurements proved Holocene ages of groundwater in the lower aquifer with sporadic admixture of modern water. Vertical hydraulic gradient and groundwater flow from the upper to the lower aquifer was established by well logging. Pumping from the lower aquifer may locally affect the upper aquifer. (Author's abstract)
W87-09580

INFLUENCE OF UNDERGROUND ENGINEERING WORKS ON HYDROGEOLOGICAL CONDITIONS OF THE SUBURBAN AREAS,
Comenius Univ., Bratislava (Czechoslovakia). Dept. of Hydrogeology.
L. Mellioris, and O. Tavoda.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 207-218, 5 fig, 1 tab, 5 ref.

Descriptors: *Model studies, *Groundwater movement, *Geohydrology, *Water table, *Suburban areas, *Hydraulic engineering, Structural engineering, Model studies, Project planning, Design criteria, Engineering geology, Construction.

In underground engineering and construction reaching below the water table a change occurs in the groundwater flow regime that is evident in increased uplift and hydrostatic pressures, local increases in filtration rate, and an increased probability of suffusion. The extent of this effect depends on the geological and hydrogeological conditions of the locality. In the Bratislava suburban area, model studies were undertaken of a planned construction of an underpass combined with a subway for pedestrians. The experimental solution was made on a planar model of the seepage by using the method of electro-hydrodynamic analogy. The underground constructions of the underpass and subway are to be built by means of hydraulically perfect construction and sealing underground walls sunk down to the impermeable Neogene strata, which excludes seepage under them. The experimental solution shows that these underground constructions will result in a hydrostatic pressure increase on the underpass walls of about 20 to 25%. Compared with older archive records,

this value shows that the groundwater table may change constantly to a considerable extent under the influence of further underground objects. (See also W87-09568) (Geiger-PTT)
W87-09581

MINE AND OPEN PIT DEWATERING AT CHINGOLA, ZAMBIA,
Nchanga Consolidated Copper Mines Limited, Chingola (Zambia). Geology Dept.
For primary bibliographic entry see Field 4B.
W87-09584

DEVELOPMENT OF A GROUND WATER HAZARD MAP FOR AN UNDERGROUND COAL MINE,
D'Appolonia Consulting Engineers, Inc., Englewood, CO.
A. G. Thurman, V. Straskraba, and R. D. Ellison.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 273-291, 5 fig.

Descriptors: *Coal mining, *Safety, *Groundwater movement, *Mapping, *Mining engineering, Mine drainage, Subsurface drainage, Coal mines, Project planning, Sandstones, Aquifers, Geohydrology, Groundwater recharge.

Groundwater conditions affecting underground coal mine planning, development and operations at an undeveloped property were investigated. Three minable seams and adjacent sandstone members, separated by shaly confining beds, act as aquifers. As a result of formation dip, head varies from zero to over 300 meters. Faulting probably connects the aquifers in localized areas. Field and laboratory data were used to establish a groundwater hazard map ranking the property by five levels of hydrogeologic complexity. By using the map with the mining plan, established with appropriate consideration of mining efficiency, safety and coal recovery, it was possible to estimate the water inflow during development of entries, initial longwall mining and sustained longwall mining for the entire period of operation. (See also W87-09568) (Author's abstract)
W87-09585

ORIGIN AND DYNAMICS OF THE WATERS FLOWING INTO THE MINING WORKS IN REOCIN (SANTANDER, SPAIN) (SOBRE EL ORIGEN Y DINAMICA DE LAS AGUAS FLUYENTES A LAS EXPLOTACIONES MINERAS DE REOCIN (SANTANDER, ESPANA)),
Universidad Autonoma de Barcelona, Barcelona (Spain). Dept. de Geodinamica Externa e Hidrogeologia.
J. Trilla Arrufat, C. F. Lopez Vera, and A. Peon Pelaez.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 293-307.

Descriptors: *Drainage engineering, *Groundwater movement, *Hydrologic models, *Groundwater recharge, *Mine drainage, *Isotopic tracers, Mining engineering, Isotope studies, Subsurface drainage, Model studies, Retention time, Aquifers, Tritium, Surface drainage, Detention time.

Reocin mine works drain a continuous volume of water reaching a maximum of about 900 liters/sec. This effort represents a quarter of the work's operating cost. Results of a major study based on available meteorological, geological, and hydrological data made it possible to propose a model about the origin and drainage of the inflow water. To clarify some model parameters, hydrochemical and isotopic studies using tritium were performed. The results of these investigations confirmed some aspects of the primary model and elucidated a rapid dynamic detention time of water in the aquifer. (See also W87-09568) (Geiger-PTT)
W87-09586

HYDROGEOLOGICAL ASPECTS OF COAL MINING UNDER STORED WATERS NEAR SYDNEY, AUSTRALIA,
Water Resources Commission, Sydney (Australia).
W. H. Williamson.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 309-328, 3 fig, 2 tab, 10 ref.

Descriptors: *Groundwater movement, *Mine drainage, *Coal mining, *Public participation, *Environmental effects, Reservoirs, Geohydrology, Aquifers, Groundwater recharge, Project planning, Permeability, Boreholes, Excavation, Coal mines.

Hydrogeological evidence figures importantly in a public inquiry on whether coal mining should be permitted under the stored waters of five dams which provide part of Sydney's water supply. Reference is made to the natural groundwater regime, entry of water into existing mines, and test bores which showed aquifer systems to be retained over the workings. Estimates are given of vertical permeability, based on water discharge from the mines. After reviewing the factors involved it was concluded that it is practical to mine under the stored waters without causing undue leakage. (See also W87-09568) (Author's abstract)
W87-09587

WATER HAZARD IN DEEP GOLD MINING OF THE FAR WEST WITWATERSRAND - SOUTH AFRICA,
Gold Fields of South Africa Ltd., Carletonville (South Africa).
J. F. Wolmarans, and F. H. Guise-Brown.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 329-346, 12 fig, 6 ref.

Descriptors: *Groundwater movement, *Mine drainage, *Mining engineering, *South Africa, *Aquifers, Geohydrology, Hydrostatic pressure, Dolomite, Groundwater recharge, Aquifer characteristics, Aquifer testing, Excavation, Weathering, Tunneling, Safety, Gold, Dewatering.

Precautionary and remedial methods are discussed in dealing with water ingress in shaft sinking, tunnelling and stoping within a mining area of 345 square kilometers. Hydrostatic pressures exceeding 295,000 kilopascals are encountered at depths approaching 3 kilometers. Water intersections over a period of more than 40 years are scrutinized to derive an explanation for a sudden inrush of 385 megaliters/day. The geohydrology is explained together with an analyses of the chemical weathering and metamorphism of the overlying pre-Cambrian dolomite aquifer. Geological concepts are applied to advise on precautionary measures. (See also W87-09568) (Author's abstract)
W87-09588

INFLUENCE OF UNDERGROUND CONSTRUCTIONS IN CRYSTALLINE ROCK ON GROUNDWATER CONDITIONS AND THE USE OF ARTIFICIAL RECHARGE TO RESTORE A LOWERED PIEZOMETRIC SURFACE,
Chalmers Univ. of Tech., Goteborg (Sweden). Dept. of Water Supply and Sewerage.
For primary bibliographic entry see Field 4B.
W87-09589

HYDROGEOLOGICAL ASPECTS OF GROUND WATER INFLOW IN THE JUKTAN TUNNELS, SWEDEN,
Centrala Driftledningen, Vaellingby (Sweden).
A. Carlsson, and T. Olsson.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 373-389, 10 fig, 4 tab, 17 ref.

Descriptors: *Tunnel construction, *Tunnel hydraulics, *Groundwater movement, *Tunnels, *Tunneling, Excavation, Subsurface drainage, Hydraulic engineering, Permeability coefficient, Design criteria, Underground powerplants.

The Juktan underground powerplant in northern Sweden requires tunnels to transfer water between two lakes to exploit the head of the River Juktan. By measuring the static water head in the rock mass surrounding the underground constructions, a marked anisotropic behavior of the hydraulic conductivity was illustrated. Rock stress measurements made in the tunnels showed that there is a correlation with respect to direction between the extreme value of the hydraulic conductivity and the compressive stress. Hydrogeological studies have demonstrated that the rock mass is heterogeneous regarding its water-bearing capacity, and the conditions for water transmission vary considerably, depending on the degree of tectonic fracturing. (See also W87-09568) (Geiger-PTT)
W87-09591

BRITISH EXAMPLES OF A HYDROGEOLOGICAL APPROACH TO THE EVALUATION OF DRAINAGE PROBLEMS IN SUBSURFACE ENGINEERING,
Institute of Geological Sciences, London (England).
S. S. D. Foster, and M. Price.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 409-428, 8 fig, 11 ref.

Descriptors: *Subsurface drainage, *Mining engineering, *Design criteria, *Geohydrology, *Drainage engineering, *Groundwater movement, Groundwater management, Tunnel construction, Case studies.

Projects involving subsurface engineering have increased steadily, both in number and complexity, during the present decade. During site investigation, failure to identify the potentially difficult problems that arise from the presence of groundwater in highly permeable strata can, and often does lead to costly delay and/or re-design during construction. The hydrogeological approach to the collection and evaluation of groundwater data differs, in both philosophy and techniques, from that normally used in civil and mining engineering site investigations. The value of such an approach is discussed, citing a number of recent British examples. (See also W87-09568) (Geiger-PTT)
W87-09593

SYSTEM OF UNDERGROUND WATER IN A KARSTIC COUNTRY AND THE TUNNELS EXCAVATED FOR WATER TRANSPORT TO ATHENS (LE REGIME DES EAUX SOUTERRAINES DANS UN PAYS KARSTIQUE ET LES GALERIES DE LA GRANDE ADDUCTION D'EAU D'ATHENES),
Univ. de Thrace, Xanthi (Greece). Lab. de Geologie d'Ingenieur.
P. G. Marinos.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 441-462, 10 fig, 26 ref.

Descriptors: *Tunnel construction, *Tunnel hydraulics, *Karst hydrology, *Groundwater movement, *Tunneling, Geohydrology, Karst, Limestone, Aqueducts, Hydraulic engineering, Subsurface drainage.

A large part of the aqueduct under construction from Mornos Dam in Central Greece to Athens consists of tunnels through limestone mountains or smaller massifs with important surface karst features. Studies of the geohydrology of the area and observations in the tunnels showed a heterogeneity of the hydrological regime with different hydraulic systems, depending on their altitude, their distance from the relief, the surface discharge points of groundwaters, and the size of the massifs. These factors play an important role in tunnel construction and operation. (See also W87-09568) (Geiger-PTT)
W87-09595

PROBLEMS OF WATER INRUSH INTO GREEK UNDERGROUND MINES WITH SPECIAL EMPHASIS TO SEA WATER INRUSH THROUGH KARSTIC LIMESTONES OR IMPERMEABLE FORMATIONS,
Athens Univ. (Greece).

G. P. Marinos, J. N. Economopoulos, and N. G. Nicolaou.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 463-475, 7 fig, 4 ref.

Descriptors: *Groundwater movement, *Mining engineering, *Mine drainage, *Seawater, *Dam construction, Dams, Limestone, Karst, Geohydrology, Coastal engineering, Marl, Clays, Tectonics, Geomorphology, Case studies, Groundwater management.

Since the country of Greece is almost completely surrounded by the sea, Greek mines face the constant threat of seawater inrush. Strong tectonic anomalies usually occur along the coast, and susceptibility to inrush is closely tied to geomorphic conditions prevailing in each area. Impermeable rock formations (marls, clays, schists, etc.) laid below sea level, as well as very permeable ones (karstic limestones and marbles) behave differently towards water inrush into Greek underground mines operating far from or near to the coast line. In the chromite mines of Central Greece, water inrushes are handled by pumping and cement grouting. Lavrion mines near Athens which consists mainly of marble and schist employ grouting of the impermeable schists and skarns to prevent seawater inrushes. The Stratonion and Olympias mines could carry out mining operations even below sea level without seawater inrush. The Aliveri lignite mine which is mainly in mesozoic limestones is exploited by the sub-level caving method of mining. At 38 m below sea level, a concrete dam was constructed to prevent seawater inrush. This measure, along with pumping and cement grouting, brought seawater inrush under control. (See also W87-09568) (Geiger-PTT)
W87-09596

FORECASTING THE RATES OF WATER INFLOWING INTO MINES,
Mining Research Inst., Budapest (Hungary).
A. Schmieder.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 511-534, 6 fig, 1 tab, 8 ref.

Descriptors: *Groundwater movement, *Mining engineering, *Mine drainage, *Forecasting, Groundwater management, Mathematical studies, Mathematical models, Geohydrology, Seepage.

The frequency of water inrushes in mines and their relationship to geohydrologic factors is analyzed. The general hydraulics of single inrushes and group inrushes are described. Water inflow rates vary and tend to increase and then decrease with time. Depending on their variations in time, the types of inflow are: drainage of caverns, inflows without throttling, and throttled rate inflows. Mathematical expressions which describe each of these inflow types are derived. A general expression which calculates the yield of simultaneous inrushes is also described. (See also W87-09568) (Geiger-PTT)
W87-09599

PIEZOMETRIC LEVEL IN FISSURE AREAS (LE NIVEAU PIEZOMETRIQUE DANS LES ZONES DE DIACLASES),
E. Sobotha.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 553-557, 6 fig, 2 ref.

Descriptors: *Geohydrology, *Geologic fractures, *Groundwater movement, *Water table, *Mine drainage, Geological surveys, Piezometric head, Seepage, Groundwater level.

During the sinking of pits and galleries, the engineering geologist makes observations which are often in contradiction to the results of geological surveys. Water table levels can be measured in the rocks. In highly disturbed strata, the groundwater level is not always uniform; a small distance is sufficient for great differences. At a distance of 100 meters from a drowned mine gallery, tension faults have been discovered which absorb water from higher groundwater, causing a dry area in the mine. (See also W87-09568) (Geiger-PTT)
W87-09601

2G. Water In Soils

FINITE ELEMENT ANALYSIS OF WATER FLOW IN VARIABLY SATURATED SOIL,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agronomy.
J. J. Kaluarachchi, and J. C. Parker.
Journal of Hydrology JHYDA7, Vol. 90, No. 3/4, p 269-291, April 1987. 10 fig, 3 tab, 11 ref, 3 append. Virginia Dept. of Health Contract 84-0003-07, USDA Project 3332301.

Descriptors: *Groundwater movement, *Soil water movement, *Unsaturated flow, *Data interpretation, *Finite element analysis, *Saturated flow, *Model studies, Saturated soil, Simulation, Computers, Costs, Comparison studies.

A two-dimensional Galerkin finite element model for water flow in variably saturated soil is presented. As fourth-order Runge-Kutta time integration method is employed which allows use of time steps at least 2 times greater than for a traditional finite difference approximation of time derivatives. For short total simulation times computer execution costs for the Runge-Kutta method are greater than for the finite difference approximation due to the start up cost of the Runge-Kutta method, but for longer simulation times the Runge-Kutta method requires considerably less computational effort even when automatic time-step adjustment is used with the finite difference procedure. A comparison of the method of influence coefficients and 2 x 2 Gaussian integration to compute element matrices indicates that the influence coefficient method reduces total execution time to 60% of that required for numerical quadrature. Computed pressure heads using the influence coefficient method and numerical integration are found to be in close agreement with each other even under conditions of highly non-linear soil properties in a heterogeneous domain. Fluxes computed by the two methods are also generally in close agreement except under extremely non-linear conditions when some deviations were observed at short simulation times. (Author's abstract)
W87-08620

CYCLES OF SOIL: CARBON, NITROGEN, PHOSPHORUS, SULFUR, MICRONUTRIENTS,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
F. J. Stevenson.
John Wiley and Sons, New York, NY. 1986. 380 p.

Descriptors: *Soil properties, *Cycling nutrients, *Carbon, *Nitrogen, *Phosphorus, *Sulfur, *Soil water, Fertilizers, Organic matter, Soil chemistry, Soil environment, Soil organic matter.

Transformations caused by microorganisms have a profound effect on the ability of soils to provide food and fiber for an expanding world population. Of paramount importance is the cycling of carbon, nitrogen, phosphorus, sulfur, and the micronutrient cations. A knowledge of the various cycles and their interactions is essential for the intelligent use of soil as a medium for plant growth and for the rational use of natural and synthetic fertilizers. Since the biochemical cycles constitute the life-line of planet earth, information relative to their functioning in terrestrial soils has direct application to other ecosystems. The text covers all major aspects of nutrient cycling, including fluxes with other ecosystems, biochemical pathways and transformations, gains and losses, chemical fixation reactions, and plant availability. Environmental issues are integrated into the classical treatment of cycling processes. Two chapters are devoted exclusively to pollution of the environment. A broad range of topics are treated, including: management of crop residues and maintenance of soil organic matter; use of soil for disposal of organic wastes; biological nitrogen fixation; denitrification; efficiency of fertilizer nitrogen use by plants; nitrates in food and water; chemistry and fate of phosphorus and sulfur; and behavior of trace elements. (Lantz-PTT)
W87-08689

INFLUENCE OF SOIL WATER CONTENT ON THE SUPPLY OF PHOSPHATE TO PLANTS,
Department of Scientific and Industrial Research, Palmerston (New Zealand). Grasslands Div.
For primary bibliographic entry see Field 2I.
W87-08705

SOIL WATER BALANCE MODEL FOR SLOPING LAND,
Whatawhata Hill Country Research Station, Hamilton (New Zealand).
For primary bibliographic entry see Field 2A.
W87-08735

VARIATION OF THE SUBSOIL HYDRAULIC CONDUCTIVITIES OF SOME NEW ZEALAND SOILS WITH CHANGES IN WATER TENSION,
Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Soil Bureau.
M. W. Gradwell.
New Zealand Journal of Agricultural Research NEZFA7, Vol. 29, No. 2, p 325-337, 1986. 4 fig, 4 tab, 7 ref.

Descriptors: *Moisture tension, *Soil-moisture tension, *Soil water movement, *Unsaturated flow, *Hydraulic conductivity, *Field capacity, New Zealand, Soil types, Regression analysis, Prediction, Pore size.

Measurements of hydraulic conductivity of soils near to field capacity, were made on 23 subsoils, using water flow through core samples pressed between 2 membranes under tension. A method of eliminating the effects of air diffusion through the membranes by reversals of flow enabled measurements to be taken at tensions of up to 0.4 bar. Hydraulic conductivities at a tension of 0.1 bar ranged from 4 times 10 to the minus 11th power to 2 times 10 to the minus 7th power m/s. Conductivities at 0.4 bar were related to those at 0.1 bar by the regression equation $y = -5.019 + 0.529\ x$, where y and x are the logarithms to base 10 of the conductivities at 0.4 and 0.1 bar respectively. For the more conductive soils, logarithmic plots of conductivity against tension were mostly almost straight lines. The ratios of conductivities measured to conductivities predicted from pore sizes (matching factors) were generally similar over the range 0.1-0.4 bar, and conductivities predicted for 1.0 bar and multiplied by these factors usually appeared to be reasonable extrapolations of the measurements. However, for slowly conductive samples, such as fragipans or a non-volcanic clay, one or both of these conditions were not met and predictions of conductivities from pore-size distributions are not considered to be advisable. (Author's abstract)
W87-08736

LEACHING LOSSES FROM IRRIGATED PASTURE: WAIAU IRRIGATION SCHEME, NORTH CANTERBURY,
Ministry of Works and Development, Christchurch (New Zealand). Water and Soil Directorate.
For primary bibliographic entry see Field 5B.
W87-08737

INFLUENCE OF LONG TERM CULTURAL OPERATIONS ON PHYSICAL AND WATER RETENTION CHARACTERS OF A RED SANDY LOAM SOIL,
Central Plantation Crops Research Inst., Kasaragod (India).
O. P. Joshi, P. T. Varghese, E. V. Nelliat, and H. H. Khan.
International Journal of Tropical Agriculture IJTADD, Vol. 4, No. 2, p 108-115, June 1986. 6 fig, 2 tab, 12 ref.

Descriptors: *Soil water, *Retention capacity, *Soil moisture retention, *Loam, *Fertilizers,

*Manure, *Tillage effects, Density, Coconuts, Porosity, Cultivation, Specific retention, Retention.

The effects of long term manurial-cum-cultural practices, imposed since 1919 and modified in 1972, on physical and water retention properties of a red sandy loam soil planted to coconut, were studied. The treatments like forking basins after inorganic fertilization, no tillage and no manuring, and tillage with organic and inorganic fertilization, showed an improvement in water holding capacity, bulk density, estimated porosity and available water capacity over the treatment of tillage alone when tested for their cumulation effect during 1982. More or less a similar trend was observed for water retained at various tensions. However, the treatments like forking basins after inorganic fertilization, no tillage and no manuring and tillage with organic and inorganic fertilization had an edge over other treatments. The data revealed that minimum disturbance of soil by way of forking after inorganic fertilization helped in maintaining better physical environment in basins of coconut palms over other treatments. (Author's abstract)
W87-08773

TEMPORAL OBSERVATIONS OF SURFACE SOIL MOISTURE USING A PASSIVE MICROWAVE SENSOR,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
T. J. Jackson, and P. O'Neill.
Remote Sensing of Environment RSEEA7, Vol. 21, No. 3, p 281-296, April 1987. 10 fig, 4 tab, 12 ref.

Descriptors: *Soil water, *Measuring instruments, *Microwave sensors, *Remote sensing, *Agricultural lands, Prediction, Density, Simulation, Drainage.

A series of 10 aircraft flights was conducted over agricultural fields to evaluate relationships between observed surface soil moisture and soil moisture predicted using passive microwave sensor observations. An a priori approach was used to predict values of surface soil moisture for three types of fields: tilled corn, no-till corn with soybean stubble, and idle fields with corn stubble. Acceptable predictions were obtained for the tilled corn fields, while poor results were obtained for the others. The source of error is suspected to be the density and orientation of the surface stubble layer; however, further research is needed to verify this explanation. Temporal comparisons between observed, microwave predicted, and soil water-simulated moisture values showed similar patterns for tilled well-drained fields. Divergences between the observed and simulated measurements were apparent on poorly drained fields. This result may be of value in locating and mapping hydrologic contributing areas. (Author's abstract)
W87-08781

TEMPERATURE MODELLING OF WET AND DRY DESERT SOILS,
California Univ., Los Angeles. Dept. of Biology.
P. S. Noble, and G. N. Geller.
Journal of Ecology JECOAB, Vol. 75, No. 1, p 247-258, March 1987. 5 fig, 1 tab, 26 ref.

Descriptors: *Soil water, *Soil temperature, *Desert soils, *Soil-water-plant relationships, *Deserts, *Model studies, Computer models, Temperature, Temperature effects, Thermal conductivity, Mathematical equations, Soil moisture, Soil moisture retention, Wind velocity, Wind, Air temperature, Sonoran Desert, California, Model testing.

As part of a study on thermal relations of desert plants, soil temperatures at various depths, soil evaporative water loss, radiation components, wind speeds and air temperature were measured hourly over a 24-hour period for a naturally dry and an artificially wet soil in the north-western Sonoran Desert in California. Also, the thermal conductivity, volumetric heat capacity and water potential of the soil were determined in the laboratory for a wide range of soil-water contents. A computer model was then developed to predict soil temperature at various depths. The measured soil temperature was generally within 1 C of that predicted by the model, and the measured net energy exchange of the soil with the atmosphere closely agreed with the predicted heat storage in the soil. A sensitivity analysis showed that maximum soil surface temperatures were markedly influenced by shortwave and longwave radiation as well as wind speed and air temperature. Model simulations showed that nearly all of the decrease in maximum temperature of a wet soil occurred above a soil-water potential of -0.2 MPa. The damping depth for daily temperature changes was about 10 cm for both wet and dry soils. When the soil was shaded by a common bluegrass, which influenced shortwave and longwave radiation as well as wind speed profiles, simulated maximum soil surface temperatures decreased about 2 C for every 10% increase in shading, indicating that nurse plants can have a substantial effect on the local microclimate. (Author's abstract)
W87-08791

MEASUREMENT OF SOIL WATER CONTENT USING THE COMBINED TIME-DOMAIN REFLECTOMETRY - THERMAL CONDUCTIVITY PROBE,
National Research Council of Canada, Ottawa (Ontario). Inst. for Research in Construction.
T. H. W. Baker, and L. E. Goodrich.
Canadian Geotechnical Journal CGJOAH, Vol. 24, No. 1, p 160-163, February 1987. 5 fig, 10 ref.

Descriptors: *Soil water, *Measuring instruments, *Time-domain reflectometry, *Thermal conductivity probe, *Data acquisition, Reflectometry, Thermal conductivity, Electrical properties, Conductivity, Field tests, Soil properties, Mathematical equations.

A two-pronged metal probe measures the thermal conductivity and apparent dielectric constant of soils in the laboratory and in the field. One prong acts as a transient line heat source probe in measuring thermal conductivity. The apparent dielectric constant of the soil is determined by the time-domain reflectometry technique, using both prongs as a parallel transmission line. Volumetric water content is determined from the apparent dielectric constant, making use of an empirical relation valid for most soils. For volumetric water contents above about 8%, the apparent dielectric constant shows a strong dependence on water content and relatively small changes can be measured; sensitivity increases with water content. For volumetric water contents less than 8%, a soil-dependent empirical relation between water content and thermal conductivity was developed that is most sensitive at lower water contents. The combined probe provides a means of monitoring the water content over a wide range of values, in the field and in the laboratory. (Author's abstract)
W87-08796

SPATIAL VARIABILITY OF SOIL WATER AND EVAPOTRANSPIRATION,
Royal Veterinary and Agricultural Univ., Copenhagen (Denmark). Dept. of Soil and Water and Plant Nutrition.
S. Hansen, and H. E. Jensen.
Nordic Hydrology NOHYBB, Vol. 17, No. 4/5, p 261-268, 1986. 5 fig, 2 tab, 3 ref.

Descriptors: *Soil water, *Evapotranspiration, *Spatial distribution, *Soil physical properties, *Soil-water-plant relationships, *Model studies, *Grasses, Grasslands, Soil types, Sand, Loam, Soil water profiles, Profiles, Mathematical studies, Mathematical equations, Hydrologic budget, Plant water potential, Simulation, Simulation analysis.

Spatial variability in evapotranspiration from a crop covered field exposed to homogeneous climatic conditions is partly caused by field variability in soil physical properties and partly by field variability in pertinent crop properties. An analysis of the spatial variability in soil water content and evapotranspiration for two 0.5 hectare grass fields of different soil texture (a coarse sand and a sandy loam) was presented. Soil physical properties and soil water profiles were determined 1 meter apart at 16 points systematically located in each field. The analysis of soil water profiles in relation to soil physical properties indicates an appreciable variability within the range of 1 meter. For this reason a relatively simple model was used to simulate the variability pattern of the evapotranspiration, taking into account the variability in plant available water content. The results of the simulations are compared with the evapotranspiration patterns determined on the basis of a short term water balance. (Author's abstract)
W87-08815

MODELLING OF UNSATURATED FLOW IN HETEROGENEOUS SOILS PART I: DETERMINISTIC SIMULATIONS OF WATER FLOW IN SOIL PROFILES,
Technical Univ. of Denmark, Lyngby.
K. H. Jensen.
Nordic Hydrology NOHYBB, Vol. 17, No. 4/5, p 269-280, 1986. 14 fig, 6 ref.

Descriptors: *Soil water, *Soil types, *Heterogeneous soils, *Unsaturated flow, *Model studies, *Simulation, Simulation analysis, Flow, Mathematical studies, Mathematical equations, Differential equations, Differential flow equations, Soil physical properties, Soil properties, Hydraulic properties.

Water flow and solute transport in the upper soil layers are processes which are of importance in many hydrological and agricultural applications. These processes are occurring in a medium which has a complex composition, since the soil is a product of both the geological formation history and various man-induced activities like agricultural development. In addition, the upper soil is subject to cyclic variations in water content in response to the variable exposure of rainfall and outer evapotranspiration demand. Simulations were described of the field conditions at different points within two research fields where comprehensive field investigations were carried out. The simulations are based on solutions to the partial differential flow equation, subject to the measured climatic conditions and the hydraulic properties in the individual soil columns. The simulations of water content and capillary pressure are compared with measurements. (See also W87-08817) (Author's abstract)
W87-08816

MODELLING OF UNSATURATED FLOW IN HETEROGENEOUS SOILS PART II: STOCHASTIC SIMULATION OF WATER FLOW OVER A FIELD,
Technical Univ. of Denmark, Lyngby.
K. H. Jensen, and M. B. Butts.
Nordic Hydrology NOHYBB, Vol. 17, No. 4/5, p 281-294, 1986. 8 fig, 1 tab, 16 ref.

Descriptors: *Soil water, *Unsaturated flow, *Soil moisture retention, *Model studies, *Stochastic hydrology, *Spatial distribution, Mathematical models, Soil physical properties, Soil properties, Soil-water-plant relationships, Statistical analysis, Permeability coefficient, Heterogeneous soils.

Modelling of soil moisture conditions in spatially variable fields is treated using stochastic methods. Spatial variability of moisture content in a vegetation covered field is partly caused by field variability in soil physical parameters. A physically based model is coupled with a statistical description of retention properties and saturated hydraulic conductivity respectively to simulate moisture conditions in heterogeneous soils. Results are compared with measurements obtained from two 0.5 hectare field sites. Simulations based on the variation in retention properties are shown to account for much of the observed variation in soil moisture conditions with some deficiencies evident close to the soil surface. Variations in saturated hydraulic conductivity alone give and incomplete description of observed variability in soil moisture conditions. (See also W87-08816) (Author's abstract)
W87-08817

LABORATORY EXPERIMENTS ON SOLUTE TRANSPORT IN NON-HOMOGENEOUS POROUS MEDIA,

Technical Univ. of Denmark, Lyngby.
For primary bibliographic entry see Field 5B.
W87-08819

WATBAL: A SEMI-DISTRIBUTED, PHYSICALLY BASED HYDROLOGICAL MODELLING SYSTEM,
Danish Hydraulic Institute, Horsholm.
J. Knudsen, A. Thomsen, and J. C. Refsgaard.
Nordic Hydrology NOHYBB, Vol. 17, No. 4/5, p 347-362, 1986. 7 fig, 2 tab, 17 ref.

Descriptors: *Hydrologic Models, *Soil water, *Runoff, *Data interpretation, *Runoff forecasting, *WATBAL model, Model studies, Hydrology, Hydrologic cycle, Comparison studies, Stanford model, SHE model, Root zone, Groundwater, Spatial distribution, Catchment areas, Hydrologic properties, Land use, Model testing, Zimbabwe, Simulation.

A semi-distributed, physically-based hydrological modelling system, WATBAL, which accounts for the entire land phase of the hydrological cycle is described. As compared with the two alternative hydrological model types, i.e., the traditional lumped, conceptual rainfall-runoff models (STANFORD model type) and the complex, fully distributed, physically-based model (SHE model type). WATBAL represents an intermediate approach. In the model, primary attention is given to the hydrological processes at the root zone level through a distributed, physically-based approach whereas the groundwater processes are simulated in less detail by use of a lumped, conceptual approach. This approach allows WATBAL to use spatially distributed input data to account for the spatial and temporal variability of meteorological conditions, vegetation and soil properties; digital satellite information can be used as input data. WATBAL was designed primarily as a tool for predicting runoff from ungauged catchments and for assessing the hydrologic effects of land use changes. The capability of the model for simulating ungauged catchments is tested using results from a recent feasibility study for medium-sized dams in Zimbabwe. (Author's abstract)
W87-08823

EFFECT OF POLLUTED AND LEACHED SNOW MELT WATERS ON THE SOIL BACTERIAL COMMUNITY--QUANTITATIVE RESPONSE,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 5C.
W87-08874

DYNAMICS OF NITROGEN AND CARBON IN SOIL DURING PAPERMILL SLUDGE DECOMPOSITION,
Maine Univ. at Orono. Dept. of Plant and Soil Sciences.
For primary bibliographic entry see Field 5E.
W87-08891

VOLATILIZATION LOSS OF NITROGEN FROM SUBMERGED SALINE SOIL,
Central Soil Salinity Research Inst., Research Station Canning Town (India).
H. S. Sen, and B. K. Bandyopadhyay.
Soil Science SOSCAK, Vol. 143, No. 1, p 34-39, January 1987. 3 fig, 2 tab, 20 ref.

Descriptors: *Volatility, *Nitrogen, *Nutrients, *Solute transport, *Saline soils, *Fertilizers, *Model studies, *Flooding, Soil types, Soil chemical properties, Sulfates, Ureas, Ammonium, Salinity, Prediction, Ammonia, Sulfur, Estimating, Estimating equations, Field tests, Floodwater, Wind.

The volatilization loss of nitrogen was studied in a submerged field at 2 levels of salinity, 3-4 dS/m (SW1) and 7-8 dS/m (SW2). Volatilization loss (kg N/ha/d) could be predicted fairly satisfactorily from the partial pressure gradient of NH3 (atm x 10 to the minus 6th power) between the floodwater and the atmosphere, ignoring the influence of kind of fertilizer (N source) and soil salinity level. The relationship was significant at P = 0.01. It is concluded that, to increase nitrogen-use efficiency for rice, an attempt should be made to place urea at some depth below the surface or to modify existing fertilizers chemically or physically for controlled release of N or to combine both to limit NH4-N in floodwater. This is particularly important in saline soils, where volatilization loss was higher than in nonsaline soils. The model used here should be tested under different wind velocities to determine its applicability under a wide range of conditions. (Doria-PTT)
W87-08892

SPRING WHEAT GROWTH AT HIGH AND LOW SOIL WATER WITH CONSTRICTED UPPER ROOTS,
South Dakota State Univ., Brookings. Dept. of Plant Science.
For primary bibliographic entry see Field 2D.
W87-08893

EFFECT OF IRRIGATION ON PERSISTENT TOXICITY OF INSECTICIDES APPLIED AS GRANULES TO SOIL TO BROWN PLANT HOPPER AND RICE SWARMING CATERPILLAR,
Kerala Agricultural Univ., Trivandrum (India).
For primary bibliographic entry see Field 5B.
W87-08897

EFFECTS OF PH AND SOIL TYPE ON CONCENTRATIONS OF ZINC, COPPER AND NICKEL EXTRACTED BY CALCIUM CHLORIDE FROM SEWAGE SLUDGE-TREATED SOILS,
Rothamsted Experimental Station, Harpenden (England).
For primary bibliographic entry see Field 5B.
W87-08911

MOBILITY OF SLUDGE-BORNE 3,3'-DICHLOROBENZIDINE IN SOIL COLUMNS,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 5B.
W87-08925

CHEMISTRY OF TENSION LYSIMETER WATER AND LATERAL FLOW IN SPRUCE AND HARDWOOD STANDS,
Tennessee Valley Authority, Muscle Shoals, AL. Air Quality Branch.
For primary bibliographic entry see Field 5B.
W87-08926

SOIL CLOGGING DURING SUBSURFACE WASTEWATER INFILTRATION AS AFFECTED BY EFFLUENT COMPOSITION AND LOADING RATE,
Wisconsin Univ.-Madison. Coll. of Agricultural and Life Sciences.
For primary bibliographic entry see Field 5C.
W87-08928

VACUUM TROUGH EXTRACTORS FOR MEASURING DRAINAGE AND NITRATE FLUX THROUGH SANDY SOILS,
North Dakota Agricultural Experiment Station, Fargo.
For primary bibliographic entry see Field 7B.
W87-08989

SOLUTE TRANSPORT DURING ABSORPTION AND INFILTRATION: A COMPARISON OF ANALYTICAL APPROXIMATIONS,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
For primary bibliographic entry see Field 7C.
W87-08990

PULSED NUCLEAR MAGNETIC RESONANCE INSTRUMENT FOR SOIL-WATER CONTENT MEASUREMENT: SENSOR CONFIGURATIONS,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 7B.
W87-08991

ANALYSIS OF VOLUME CHANGE IN UNCONFINED UNITS OF SOIL,
Commonwealth Scientific and Industrial Research Organization, St. Lucia (Australia). Div. of Soils.
D. McGarry, and K. W. J. Malafant.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 290-297, March-April 1987. 5 fig, 6 tab, 30 ref.

Descriptors: *Volume, *Soil water, *Soil properties, *Model studies, *Soil structure, *Comparison studies, Performance evaluation.

The assessment of volume change with associated change in water content has been widely used to assess soil structural quality. The possibility of inter-experiment comparisons has been minimized both by the lack of a theoretically based model for predicting volume change, and the non-standardization of coordinates to define the data. Three models which have been or could be used to describe soil shrinkage curves - the specific volume versus gravimetric water content relationship - are derived; the three straight lines model, the general soil volume change equation and the logistic model. The important parameters of the models are specified and their interpretation with regard to soil properties given. The three models are compared both theoretically and for worked examples, the latter using published data from Austin Clay (U.S.A.), Hanslope Series (U.K.) and a Typic Pellustert (Australia). The three straight lines model not only performs well for the data presented but also provides model parameters which have direct physical interpretation within soil science. (Author's abstract)
W87-08992

FIELD METHOD FOR ESTIMATING HYDRAULIC CONDUCTIVITY AND MATRIC POTENTIAL-WATER CONTENT RELATIONS,
Utah Agricultural Experiment Station, Logan.
U. Shani, R. J. Hanks, E. Bresler, and C. A. S. Oliveira.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 298-302, March-April 1987. 4 fig, 2 tab, 16 ref.

Descriptors: *Measuring instruments, *Soil water, *Hydraulic conductivity, *Matric potential, *Drippers, Soil properties, Flow equations, Steady state, Ponding, Moisture content, Performance evaluation.

A method, using 'drippers' to estimate the soil hydraulic properties, based on assumed relationships of the hydraulic conductivity (K)-matric head (h), is proposed. The method is based on the observation that when water is applied at a constant rate to a point on the soil surface, a ponded zone is created that approaches a constant area in a short time. Thus, steady-state solutions of the two-dimensional flow equation can be applied. The method is simple to apply and consists of the following steps: (i) Wet the soil from a dripper with several known discharge rates on a relatively level dry soil. A wide range of dripper discharges is needed for a good 'spread out' of the data. (ii) Once the borders of the ponded zone are steady, saturated hydraulic conductivity (K sub s) and the matric flux function (F) can be evaluated from a regression of flux vs. the reciprocal of the ponded radius. The other soil hydraulic parameters can be derived according to the hydraulic relations assumed. Where an exponential hydraulic conductivity (K)-matric head (h) relation is assumed, these measurements are sufficient so K sub s and alpha (soil parameter) are determined. If the 'Brooks-Corey' relations of K-h and water content (theta)-h are assumed, measurements of the saturated and residual water content (theta sub s, theta sub o) and of the sorptivity (S) are required. The sorptivity is determined by measuring the horizontal wetting front advance from the ponded zone borders as a function of time on the soil surface. The method can be performed on undisturbed field soil. Contin-

uous measurements are possible at about the same site. Measurements of the change of soil water properties, with time, at the soil surface are easily made. A comparison of hydraulic parameters measured and estimated by two other methods for these soils show good agreement with the dripper method. (Author's abstract)
W87-08993

ELIMINATION OF TIME ASSIGNMENT BIAS IN ESTIMATES OF DISPERSION COEFFICIENT,
Science and Education Administration, University Park, PA. Northeast Watershed Research Center.
For primary bibliographic entry see Field 7C.
W87-08994

KINETICS OF SULFATE ADSORPTION AND DESORPTION BY CECIL SOIL USING MISCIBLE DISPLACEMENT,
Clemson Univ., SC. Dept. of Horticulture.
S. C. Hodges, and G. C. Johnson.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 323-331, March-April 1987. 5 fig, 4 tab, 51 ref.

Descriptors: *Acid rain, *Path of pollutants, *Miscible displacement, *Kinetics, *Sulfates, *Adsorption, *Desorption, *Soil types, Model studies, Diffusion, Chemical reactions.

The kinetics of SO4(2-) adsorption and desorption at 4, 22, and 40 C by untreated and CaCl2-treated samples of a Cecil Bt2 horizon were studied using miscible displacement and a rapidly stirred batch procedure. Adsorption data was plotted according to the linear forms of the first order, Elovich, parabolic diffusion, and shell progressive particle and film diffusion equations. The latter two equations consider the effects of strong interaction between SO4(2-) and the soil surface on diffusion. The shell progressive particle diffusion, the Elovich, and the first-order equations provided the best fits of the adsorption data (R squared values > 0.95). The desorption data was best fit by the shell progressive particle diffusion, the Elovich, and the parabolic diffusion equations. Desorption of SO4(2-) by KCl was not reversible within a period of two times that of the adsorption period. Decreases in the apparent reaction rate coefficients (slopes of the regression equations) were unexpectedly observed with increasing temperature for the untreated samples, indicating that soil-bound Al may affect the rate of SO4(2-) reactions as well as the quantities of SO4(2-) adsorbed. Under the assumption that the miscible displacement procedure more accurately models the field situation, a batch equilibrium isotherm procedure overestimated the SO4(2-) adsorption capacity, and the rapidly stirred batch procedure underestimated the time required for SO4(2-) to react with soil surfaces. Dependency of the reaction rate coefficients on the mixing rate and flow rate, a limited temperature dependency, and the good fit of the data by the shell progressive particle diffusion model indicate that the apparent reaction rate in the miscible displacement procedure is controlled by diffusion of SO4(2-) through a reacted soil particle or aggregate rather than an elementary chemical reaction or diffusion through the film surrounding soil particles. (Author's abstract)
W87-08995

REDUCTION IN HYDRAULIC CONDUCTIVITY IN RELATION TO CLAY DISPERSION AND DISAGGREGATION,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
T. M. Abu-Sharar, F. T. Bingham, and J. D. Rhoades.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 342-346, March-April 1987. 3 fig, 5 tab, 11 ref.

Descriptors: *Hydraulic conductivity, *Permeability coefficient, *Soil types, *Soil water, *Dispersion, *Clay, Disaggregation, Calcium, Sodium, Pores.

The saturated hydraulic conductivities (HCs) of three California soils (Arlington, Fallbrook, and Pachappa Haplic; Durixeralfs, Typic and Mollic Haploxeralfs, respectively) were determined at successively diluted electrolyte solutions with a constant sodium adsorption ratio (SAR) of 0 or 10, followed by deionized water. When these soils were Ca-saturated and then leached with deionized water, very little clay dispersion (0-0.05 g soil/column) occurred and yet the HC was reduced to about 2, 24, and 72% of the maximum HCs for Fallbrook, Arlington, and Pachappa soil columns, respectively. At SAR 10, replacement of the most dilute solution (2.5 mol/cu m) with deionized water resulted in a rapid reduction in the HC to zero for both the Arlington and Fallbrook soils. The appearance of clay in the effluent solutions indicated that the dispersed clay was mobile in the soil columns and thus not plugging a major part of the soil pores. The major cause of reductions in HC is concluded to be the reduction of large conducting pores as a result of aggregate failure (slaking). This conclusion is supported by the fact that the HC of Fallbrook soil, which contained the least stable aggregates, was reduced to zero despite its having the greatest proportion of macropores; and that clay dispersion did not cause plugging of conducting pores for the Pachappa soil, which had the most stable aggregates despite its having the highest proportion of micropores. (Author's abstract)
W87-08996

EFFECT OF SEWAGE SLUDGE ON SOIL STRUCTURAL STABILITY: MICROBIOLOGICAL ASPECTS,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
For primary bibliographic entry see Field 5C.
W87-08997

APPLICATION OF SOIL CONDITIONER SOLUTIONS TO SOIL COLUMNS TO INCREASE WATER STABILITY OF AGGREGATES,
Technion - Israel Inst. of Tech., Haifa. Faculty of Agricultural Engineering.
A. Shaviv, I. Ravina, and D. Zaslavsky.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 431-436, March-April 1987. 6 fig, 2 tab, 25 ref.

Descriptors: *Anionic polymers, *Soil treatment, *Soil columns, *Soil stabilization, Drip irrigation, Aggregates, Convection, Flow, Soil water, Silt, Clay, Loam.

Soil aggregate stabilization by water-soluble anionic polymers (soil conditioners) applied by drip irrigation was studied in columns containing silt loam and clay aggregates. Soil conditioners moved during irrigation to depths similar to the wetting front depth (30 cm) and increased aggregate water stability. Conditioning depth was controlled mainly by convective flow through the soil profile. Distribution of conditioner macromolecules, which affects the size of water-stable aggregates, was controlled by both convective flow into aggregates and molecular diffusion. Conditioning depth and mean diameter of water-stable aggregates were found to depend on initial aggregate size, initial soil moisture content, application flux rate, polymer molecular weight, solution concentration, and total applied volume. Conditioning effect was more apparent in silt loam than in clay loam. Best conditioning results were obtained for silt loam aggregates at a moisture content somewhat lower than field capacity, treated with polymers of molecular weight $> 75{,}000$ at concentrations > 4 g/L applied at a small flux rate of .0015 cm/s (50 mm/h). Conditioners of molecular weight $< 75{,}000$ acted better than those of $> 75{,}000$ in increasing water stability of aggregates in the surface layer. (Author's abstract)
W87-09005

DYNAMICS OF SULFATE RETENTION BY ACID FOREST SOILS IN AN ACIDIC DEPOSITION ENVIRONMENT,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
For primary bibliographic entry see Field 5B.
W87-09008

FOREST SOIL ORGANIC HORIZON ACIDIFICATION: EFFECTS OF TEMPERATURE, TIME, AND SOLUTION/SOIL RATIO,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy.
B. R. James, and S. J. Riha.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 458-462, March-April 1987. 4 fig, 2 tab, 19 ref.

Descriptors: *Acid rain, *Air pollution effects, *Soil horizons, *Acidification, *Temperature effects, *Forest soils, *Soil properties, Model studies, Simulation, Seasonal variation, Aluminum, Ions.

A forest soil organic horizon (Oe) was acidified with HNO3 (0-5 cmol/kg) in the laboratory at three solution/soil ratios (10, 50, 100), three temperatures (4, 14, 30 C), and for up to 162 h to compare effects of added H(+) on pH, soluble Ca, Al, and C with effects of environmental conditions likely to vary seasonally in the forest floor. Soil suspension pH reached a steady state within 48 h, regardless of quantity of H(+) added, solution/soil ratio, or temperature. Calcium concentrations also reached a steady state with soil solid phases quickly, and additions of H(+) increased quantities of Ca (mmol/kg) in solution as did increasing solution/soil ratio. Shaking time and temperature had smaller effects on Ca than did H(+) additions and solution/soil ratio. In contrast, reactions controlling dissolved organic carbon (DOC) and total soluble aluminum (Al sub t) were slower than those for pH and Ca. Quantities of DOC and Al going into solution remained nearly constant, so than increasing the solution soil ratio diluted concentrations. Dissolved organic C and soluble Al increased with longer shaking times and higher temperature. The results have implications for designing realistic laboratory experiments on forest floor acidification, for evaluating seasonal and yearly variations in soil solution composition in the field, and in developing accurate and reliable simulation models of H(+) reactions in forest soils. (Author's abstract)
W87-09009

FIRST-ORDER RELIABILITY APPROACH TO STOCHASTIC ANALYSIS OF SUBSURFACE FLOW AND CONTAMINANT TRANSPORT,
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-09017

QUASI-SOLUTION OF RICHARDS' EQUATION FOR THE DOWNWARD INFILTRATION OF WATER INTO SOIL,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
D. Swartzendruber.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 809-817, May 1987. 6 fig, 1 tab, 18 ref.

Descriptors: *Data interpretation, *Richards' equation, *Infiltration, *Soil water, *Mathematical equations, Equations, Performance evaluation.

A new equation is presented that expresses depth Z of soil water content theta at time t as an explicit function of theta and t and holds for all $t >$ or $=$ 0. The new Z(theta, t) includes the classical J. R. Philip solution for asymptotically large times. At moderate times, the new Z(theta, t) is matched to the classical Philip solution expressed as phi (square root t) + chi to the t power + psi (square root t) cubed + omega (t squared) + ..., where phi, chi, psi, omega...are different functions of theta alone. The matching process enables the characterizing functions (or parameters) within Z(theta, t) to be evaluated in straightforward fashion from the moderate-time Philip functions (phi, chi, psi, omega,...). When evaluated for either Philip's data or the Green and Ampt step-function solution, the new Z(theta, t) in each case describes the water content profiles with excellent accuracy for all times. Also, for all $t >$ or $=$ 0, the new Z(theta, t) can be directly integrated to provide a new equation for cumulative quantity of water

infiltrated or flux, both as explicit functions of time. (Author's abstract)
W87-09019

GRAVITY DRAINAGE ANALYSIS FOR SCALE HETEROGENEOUS POROUS MATERIALS UNDER FALLING WATER TABLE CONDITIONS,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
K. K. Watson.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 818-826, May 1987. 15 fig, 8 ref.

Descriptors: *Infiltration, *Gravity drainage, *Porous media, *Water table fluctuations, *Numerical analysis, Flow, Equations, Heterogeneity, Model studies, Comparison studies, Sand, Grain size.

The gravity drainage of two profiles of porous material exhibiting scale heterogeneity in the vertical direction is studied for stationary and falling water table conditions using a computer-based numerical analysis of the partial differential equation describing flow in unsaturated porous materials. Results presented in the form of pressure head profiles indicate the complex pressure head conditions that may arise with certain distributions of heterogeneity and certain rates of fall of the water table. Equations based on the Green and Ampt assumptions are also developed for the gravity drainage process in scale heterogeneous materials, and results using the sharp-front model are compared with the numerically obtained results. The comparisons in terms of the relationship between cumulative drainage outflow and time showed satisfactory correspondence when the median grain size of the heterogeneous profile lay in the fine sand range. However, the correspondence was less satisfactory for a profile with a coarse sand median grain size. (Author's abstract)
W87-09020

MOBILIZATION OF ALUMINUM IN A NATURAL SOIL SYSTEM: EFFECTS OF HYDROLOGIC PATHWAYS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W87-09024

ROBUST-RESISTANT SPATIAL ANALYSIS OF SOIL WATER INFILTRATION,
Iowa State Univ., Ames. Dept. of Statistics.
For primary bibliographic entry see Field 7C.
W87-09029

HUMIC SUBSTANCES IN SOIL, SEDIMENT, AND WATER: GEOCHEMISTRY, ISOLATION, AND CHARACTERIZATION.
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2H.
W87-09067

GEOCHEMISTRY OF HUMIN,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2H.
W87-09077

FRACTIONATION OF SOIL HUMIC SUBSTANCES,
Lincoln Coll., Canterbury (New Zealand). Dept. of Soil Science.
R. S. Swift.
IN: Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization. John Wiley and Sons, New York, NY. 1985. p 387-408, 9 fig, 2 tab.

Descriptors: *Soil chemistry, *Chemical analysis, *Fractionation, *Humic acids, Hydrogen ion concentration, Organic solvents, Metals, Chromatography, Ultrafiltration, Centrifugation, Electrophoresis, Adsorption.

Successful fractionation of humic substances can extend knowledge of their molecular properties, assist in their characterization, and aid in the meaningful application of analytical techniques. A wide range of procedures has been used to achieve fractionation. Classical methods of fractionation involve the adjustment of pH and the addition of salts, organic solvents, or metal ions. More recently, very good fractionations have been carried out on the basis of molecular size differences, using gel permeation chromatography, ultrafiltration, and centrifugation. Similarly, electrophoresis isoelectric focusing and isotachophoresis have been used to produce fractionations on the basis of electrical charge. Adsorption onto a variety of media followed by selective desorption has also proved a useful technique. In most instances, recent developments in techniques or in the support media available have led to improvements in the fractionations which can be achieved. While there is always room for improvement and refinement, the currently available procedures produce good results if properly understood and industriously applied. (See also W87-09067) (Author's abstract)
W87-09081

RAINFALL ABSTRACTIONS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W87-09099

SIMULATION OF THE HYDROLOGIC CYCLE FOR WATERSHEDS,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 2A.
W87-09111

ALTERNATIVE PROCEDURE FOR DETERMINING THE SHRINKAGE LIMIT OF SOIL,
Water and Power Resources Service, Denver, CO. Engineering and Research Center.
J. G. Byers.
Available from the National Technical Information Service, Springfield, Virginia, 22161. Bureau of Reclamation Report No. REC-ERC-86-2, June 1986. 29 p, 9 fig, 5 tab, 8 ref, 2 append.

Descriptors: *Soil shrinkage, *Testing procedures, *Soil water, Soil compaction, Mercury, Soil types, Paraffin, Data interpretation.

This study investigates an alternative method for determining the shrinkage limit of soils and concentrates on comparing the results of tests performed using mercury with those performed using water for soil pat volume determination. Duplicate specimens were tested to determine the precision and repeatability of shrinkage limit values obtained using the Earth Manual (mercury) procedure and the alternative (wax) procedure. Data indicate that results obtained from either the alternative (wax) method or the standard (mercury) method are reasonably precise and repeatable. While the alternative (wax) procedure may produce shrinkage, limit values slightly higher than those obtained using the standard (mercury) procedure, it is considered a valid test method. However, when the shrinkage limit of a soil is critical or when unusual soil types are encountered, the standard (mercury) method is recommended because of the historical data base available. The principal advantage of the wax method is the elimination of mercury from repetitive laboratory tests, for health and safety reasons. Instead of immersing a bare soil pat in mercury, paraffin-coated soil specimens are immersed in water to determine the volume of the ovendried pat. (Lantz-PTT)
W87-09159

ACID NEUTRALIZING CAPACITY OF FINE SOIL FRACTIONS,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
J. R. Kramer, W. G. Booty, and S. Stroes.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 327-337, 1 fig, 2 tab, 11 ref.

Descriptors: *Fate of pollutants, *Soil filters, *Acidity, *Neutralization, Acid rain, Path of pollutants, Drainage, Groundwater, Soil water, Clay, Quartz, Shale, Illite, Kaolinite.

Chemical conditions in lakes and streams are mainly the result of reactions in the soil system and the bedrock. Acidic precipitation and many soil-forming processes can lead to an acidification of the soil and soil water. THe ultimate acid neutralizing capacity (ANC) of a drainage system is determined by the reaction of consolidated and unconsolidated soils and rocks in the watershed with surface and groundwaters. The capacity of clay minerals and organic humus to react with protons of acid precipitation and to buffer the pH of water in a noncalcareous regime is most important. In order to determine the nature and magnitude of the acid neutralization reactions of common soil minerals, several American Petroleum Institute reference clays, quartz, and natural soil samples of low CEC from northwestern Ontario watersheds have been titrated with acid at constant ionic strength. Acid titration in constant ionic medium over the range to pH of about 3 in 1-1.5 hours can be explained by a double langmuir type function. One sample can be explained by an adsorption-dissolution function. This function could be used to indicate the acid-neutralizing capacity if the cation exchange capacity is known. (See also W87-09164) (Lantz-PTT)
W87-09180

HYDROLOGY AND DRAINAGE OF PEATLAND,
Foras Taluntais, Ballinrobe (Ireland).
J. Mulqueen.
Environmental Geology and Water Sciences EGWSEI, Vol. 9, No. 1, p 15-22, 1986. 7 fig, 3 tab, 13 ref.

Descriptors: *Hydrology, *Drainage, *Peat bogs, *Waterlogging, Soil types, Peat, Peat soils, Mosses, Trees, Organic matter, Decomposing organic matter, Aridity, Bogs, Wetlands, Decomposition, Phosphorus, Soil physical properties, Glacial drift, Geologic formations, Bedrock.

The formation of peat in a hydrological context and the drainage of peat deposits are examined through the application of drainage theory to peat and subpeat deposits, including glacial drift and bedrocks. Complete decomposition of accumulated peat is primarily inhibited by a deficiency of oxygen induced by waterlogging. In the upper layers of raised bogs and in the so-called blanket bogs, acidity and very low levels of phosphorus may also contribute to impairing decomposition. Peat types have been classified into blanket, raised, and fen peat. Further subdivisions have been made on the basis of the plant composition and degree of decomposition. Blanket peat cover the landscape, hill and valley. Raised peats are confined to low-lying ground and valleys, and higher ground often protrudes through as islands of mineral and soil ground. The blanket/raised/fen classification has relevance to hydrology and drainage, in particular to the mode of formation and to the type of drainage solution including outfalls. The nature of the plant composition and degree of humification have relevance chiefly to physical properties but especially permeability, bulk density, and moisture content, which also relate to hydrology and drainage. (Author's abstract)
W87-09201

PHYSICAL CHANGES INDUCED BY RAINFALL IN THE SURFACE LAYER OF AN ALFISOL, NORTHERN NIGERIA,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Soil Science.
K. B. Adeoye.
Geoderma GEDMAB, Vol. 39, p 59-66, 1986. 1 fig, 7 tab, 7 ref.

Descriptors: *Nigeria, *Rainfall, *Soil types, *Soil properties, *Soil porosity, *Infiltration, Density, Porosity, Soil aggregates, Cultivation, Mulches, Rainfall distribution.

Bulk density, porosity, aggregate sizes, penetrability, and infiltration were measured periodically to

assess physical changes induced by rainfall in the surface layer of an Alfisol under the following treatments: undisturbed and bare, bare with frequent shallow cultivations, and a 7-cm thick layer of grass mulch. Treatments were imposed after initial tillage. Physical changes in the unmulched plots occurred rapidly during the first rains. Bulk density increased by an average of 0.09 g/cu cm per 50 mm of rainfall, and aeration porosity at a suction of 100 cm decreased by more than 70%. Large aggregates were broken down into smaller ones. Infiltration rates declined with time, and by the end of the season were down to 25% of their initial values in the bare plots. Surface layers had undergone evident hardening as well. Periodic hoeing kept the surface layer in better physical condition than did hand-weeding alone. Aggregation remained greater, surface hardening lower, and infiltration rate higher in the hoed plots. In contrast to the bare plots, the mulched plots retained favorable physical conditions in their surface layers throughout the rainy season. (Author's abstract)
W87-09214

INFLUENCE OF SOIL CHARACTERISTICS AND ENVIRONMENTAL CONDITIONS ON SEASONAL VARIATIONS OF WATER-SOLUBLE PHOSPHATE IN SOILS,
Western Washington Research and Extension Center, Washington State Univ., Puyallup, Wash. 98371-4998.
S. Kuo, and E. J. Jellum.
Soil Science SOSCAK, Vol. 143, No. 4, p 257-263, April 1987. 6 fig, 2 tab, 28 ref.

Descriptors: *Phosphates, *Soil properties, *Seasonal variation, Nutrients, Mineralization, Corn, Wheat, Climate, Phosphorus.

The seasonal variation of water-soluble phosphate (P) in a Sultan silt loam (Aquic Xerofluvents) with and without wheat or corn residue amendment was investigated. The soil was cropped to corn (Zea mays L.) immediately after the residues were incorporated. The P soluble in water and pH for the soil showed a similar annual pattern regardless of residue treatments; they were generally low during the drier and warmer spring and summer, gradually increased in the fall, and reached a maximum during the winter high-rainfall period. High correlations between water-soluble P and soil pH ($r = 0.75$-0.88, $P < 0.01$) and between water-soluble P and inorganic N (NH(+)4-N and NO3(-)N) ($r = -0.65$--0.88, $P < 0.01$, depending on residue treatment) were observed, indicating that the seasonal variations of water-soluble P could largely be explained by these two soil characteristics. Because soil pH and water-soluble P were both negatively correlated with temperature and with NO3(-)N levels in the soil and could be further decreased with increasing rates of N application, the biological mineralization of organic N and the transformation of NH(+)4-N to NO3(-)N likely played an active role in the seasonal pattern of water-soluble P in the soil. (Author's abstract)
W87-09257

MODELING THE FLOW OF IMMISCIBLE FLUIDS IN SOILS,
Dept. of Soil Science, National Chung Hsing Univ., Taichung, Taiwan, Republic of China.
C. Lin.
Soil Science SOSCAK, Vol. 143, No. 4, p 293-300, April 1987. 1 fig, 12 ref.

Descriptors: *Data interpretation, *Soil water, *Soil water movement, *Unsaturated flow, *Model studies, *Immiscible fluids, *Flow models, Darcy's law, Numerical analysis, Mathematical equations.

A model for the flow of two incompressible and immiscible fluids in soils, developed by combining a modified Darcy's law with the continuity equations is reported. The resulting equations are of a system of nonlinear partial differential equations. Numerical analysis, based on the finite element method and Newton-Raphson's method, to solve the equations is given and discussed. Computer simulations of the flow of water and trichloroethylene in sands are also shown. (Author's abstract)
W87-09258

SEEPAGE REGIME IN THE FOUNDATION OF THE KANEV HYDROELECTRIC STATION,
For primary bibliographic entry see Field 8D.
W87-09364

WASTEWATER-INDUCED SOIL CLOGGING DEVELOPMENT,
RSE Group, Ayres Association, Madison, WI 53704.
For primary bibliographic entry see Field 5C.
W87-09373

MEASUREMENT OF WATER POTENTIAL IN LOW-LEVEL WASTE MANAGEMENT,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 7B.
W87-09456

2H. Lakes

BIOLOGICAL EFFECTS OF CONTINUOUS AND INTERMITTENT DOSING OF OUTDOOR EXPERIMENTAL STREAMS WITH CHLOROPYRIFOS,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5C.
W87-08634

FIELD CONFIRMATION OF A LABORATORY-DERIVED HAZARD ASSESSMENT OF THE ACUTE TOXICITY OF FENTHION TO PINK SHRIMP, PENAEUS DUORARUM,
Environmental Research Lab., Gulf Breeze, FL.
For primary bibliographic entry see Field 5C.
W87-08638

BROOD SIZE AND NEONATE WEIGHT OF DAPHNIA MAGNA PRODUCED BY NINE DIETS,
Dow Chemical U.S.A., Midland, MI. Dept. of Environmental Quality.
U. M. Cowgill, D. L. Hopkins, S. L. Applegath, I. T. Takahashi, and S. D. Brooks.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 233-244, 2 fig, 3 tab, 11 ref.

Descriptors: *Daphnia, *Food habits, *Nutrients, *Lake Huron, Algae.

The purpose of this study was to discover which of nine diets would produce the largest mean brood size in Daphnia magna. Two media, one inorganic and one organic, were employed to culture three green algae: Selenastrum capricornutum, Ankistrodesmus convolutus, and Chlamydomonas reinhardtii. In addition to single algal foods, mixtures of algae were also employed. These consisted of S. capricornutum and C. reinhardtii, which were fed in varying quantities. A synthetic diet of fish chow and alfalfa served as a control. All algal diets were bacteria-free. Neonates were acclimatized in autoclaved Lake Huron water and reared on one of the nine diets for five weeks. Demographic studies were carried out on the progeny of these acclimatized adults. First broods began to arrive after seven days. Thereafter, every other day, neonates were collected, and weighed. These data presented in this study are based on 49,982 neonates. Daphnia magna consuming algae reared on inorganic medium were less productive than those consuming algae reared on organic medium. The largest mean brood size was obtained from the mixed algal diet reared on the organic medium while the smallest mean brood size was produced by the synthetic diet. Large broods generally consisted of lighter individuals (10.8 micrograms/neonate) than those produced in smaller broods (20 micrograms/neonate). The evolutionary significance of this observation, as well as its effect on chronic life cycle studies is discussed. (See also W87-08624) (Author's abstract)
W87-08641

EFFECTS OF AN ACIDIC RIVER, CAUSED BY ACIDIC RAIN, ON WEIGHT GAIN, STEROIDOGENESIS, AND REPRODUCTION IN THE ATLANTIC SALMON (SALMO SALAR),
Halifax Fisheries Research Lab. (Nova Scotia). Fisheries and Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W87-08651

MODEL FOR ESTIMATING THE LOADING RATE OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN TO THE GREAT LAKES,
Dow Chemical Co., Midland, MI. Agricultural Research Lab.
For primary bibliographic entry see Field 5B.
W87-08660

MODELING CHEMICAL TRANSPORT IN LAKES, RIVERS, AND ESTUARINE SYSTEMS,
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W87-08672

DEFENDING OUR LAKESHORES,
For primary bibliographic entry see Field 4D.
W87-08674

MACROFOSSIL AND POLLEN REPRESENTATION OF CONIFEROUS TREES IN MODERN SEDIMENTS FROM WASHINGTON,
Washington Univ., Seattle. Quaternary Research Center.
P. W. Dunwiddie.
Ecology ECOLAR, Vol. 68, No. 1, p 1-11, February 1987. 7 fig, 2 tab, 43 ref. NSF Grant DEB-8107491.

Descriptors: *Coniferous forests, *Species composition, *Limnology, *Ecology, *Pollen, *Paleohydrology, *Sedimentation, *Pond sediments, Pacific Northwest, Washington, Fossils, Taxonomy.

Fossil pollen assemblages from bog and lacustrine sediments provide data for reconstructing vegetation histories and for documenting changes in plant species distributions. Pollen and conifer needle macrofossils were collected for surface sediments in 30 ponds near Mount Rainier to study representation of forest trees in data from modern sediments. Percentages of major tax calculated from these data were compared with basal area measures of forest composition within 30m of each pond. It was found that fossil needle assemblages can provide estimates of past species composition in coniferous forests in the Pacific Northwest. Pollen percentages of most conifer taxa were twice the values reported in another study from Mount Rainier using moss polsters. Comparisons between the macrofossil and the pollen data indicate that conifer macrofossil assemblages more accurately reflect forest composition near sample sites, and also provide greater taxonomic resolution. (Author's abstract)
W87-08690

ECOLOGICAL AND PHYSIOLOGICAL DIFFERENTIATION AMONG LOW-ARCTIC CLONES OF DAPHNIA PULEX,
Windsor Univ. (Ontario). Dept. of Biology.
L. J. Weider, and P. D. N. Hebert.
Ecology ECOLAR, Vol. 68, No. 1, p 188-198, February 1987. 8 fig, 4 tab, 34 ref.

Descriptors: *Limnology, *Tundra ponds, *Population dynamics, *Arctic, *Cladocera, *Clones, *Daphnia, *Salinity, Electrophoresis, Osmosis, Manitoba, Canada.

A distributional survey of obligately parthenogenetic clonal groups belonging to the Daphnia pulex complex was conducted on rock bluff and tundra ponds near Churchill, Manitoba. Clonal distributions were spatially heterogeneous. The clonal patterns of microgeographic heterogeneity suggested a strong association of Daphnia clonal type with salinity/conductivity gradients in pond habitats that varied in their proximity to Hudson Bay.

Acute salinity tolerance experiments showed significant differences in survivorship of six clonal isolates at salinities encountered in nature. Clones from high salinity ponds had greater survivorship than clones from low salinity ponds. There was no significant differences in clonal survivorship at low salinities. Clonal differences were also found in hatching success of ephippial eggs at different salinities. Laboratory measurements of hemolymph osmolality from these clones indicated significant differences in osmoregulatory capacity. Coupled with morphological and electroporetic data, the ecophysiological differences among D. pulex clones from Churchill suggest strongly that this Daphnia complex consists of physiologically different ecotypes. The ecological and evolutionary implications of these data are discussed. (Author's abstract)
W87-08691

ECOLOGICAL CONSEQUENCES OF ARTIFICIAL CHANGES IN THE WATER REGIME OF LAKES AND THEIR SIGNIFICANCE FOR FORECASTING,
For primary bibliographic entry see Field 6G.
W87-08708

PRODUCTION-DESTRUCTION PROCESSES IN ECOSYSTEMS OF GRASSY MARSHES OF THE AMUR RIVER REGION,
T. A. Kopoteva.
Soviet Journal of Ecology SJECAH, Vol. 17, No. 3, p 143-148, January 1987. 7 tab, 13 ref. Translated from Ekologiya, No. 3, p 35-41, May-June 1986.

Descriptors: *Wetlands, *Marshes, *Eutrophic marshes, *Biomass, *Limnology, Growth, Decomposition, Vegetation, USSR, Grasses.

Data are presented on the seasonal dynamics of the phytomass of two eutrophic grassy marshes, studied over the course of three years. Using a method of 'minimum estimate' with consideration for peaks of phenological groups, values for growth and decomposition of vegetative matter were calculated. It was revealed that xerozation of the conditions under the influence of burns and hydrothermal factors makes possible a drop in the productivity of grassy marshes and an increase in the decomposition of vegetative matter. (Author's abstract)
W87-08709

ECOLOGICAL AND STATISTICAL PROGNOSIS OF THE DYNAMICS OF FISH CATCH BASED ON DENDROCHRONOLOGICAL DATA,
E. A. Vaganov, A. V. Shashkin, and L. G. Vysotskaya.
Soviet Journal of Ecology SJECAH, Vol. 17, No. 4, p 187-193, March 1987. 6 fig, 15 ref. Translated from Ekologiya, No. 4, p 3-10, July-August 1986.

Descriptors: *Limnology, *Rivers, *Fish catch, *Population dynamics, *Dendrochronology, Statistics, Growth, USSR, Model studies.

The correlation between two biological processes under experimental ecological contitions: the dynamics of growth in woody plants and the dynamics of growth in fishes were studied, and the possibility of using dendrochronological data for compiling a simple numerical model of catch of fishes inhabiting certain conditions was investigated. An analysis of dynamics of cell sizes in annual rings of larch growing in the arctic range of a forested region (Khatanga) showed that the best index of variation in the thermal regime is maximum size of cells in the ring, reflecting both the average temperature of the warm months of the growing seasons, and the duration of the season. It also shows that the dynamics of this index very clearly reveals the cyclic nature to have a duration of approximately 20 years. However, despite the presence of good correlation between maximum cell sizes and the thermal regime of the summer months, no dependences between temperature and cell sizes close to the functional ones were found. The maximum size of the cells is a rather complex index of changes in the thermal regime, and reflects the variability of 'physiological' temperature. This term is understood to mean a certain combination of seasonal temperature conditions, which forms an annual ring with a specific structure and definite maximum cell size. The approach to ecological forecasting examined can apparently be disseminated not only to ecologfical; systems and growth and developmental processes limited by one environmental factor. Indeed, several ecological factors may influence growth and developmental processes each year, and the links between characteristics of the compared processes and the set of factors therefore do not, in general , functionally coincide. However, in the presence of temporal progress in one of the processes relative to another, part of the known temporal series of natural changes in characteristics of the former may be used for comparison with the latter in the search, for example, for a multiple regression model for calculating characteristics of the second process, and the remaining part of the temporal series can be used for verifying the correctness of the obtained regression model and the forcast based on it. (Alexander-PTT)
W87-08711

INTERRELATIONSHIPS OF ALGAE AND BACTERIA DURING METHANE OXIDATION,
P. P. Umorin, and L. S. Ermolaeva.
Soviet Journal of Ecology SJECAH, Vol. 17, No. 4, p 205-208, March 1987. 2 fig, 1 tab, 16 ref. Translated from Ekologiya, No. 4, p 23-27, July-August 1986.

Descriptors: *Algae, *Bacteria, *Methane, *Oxidation, Substrates, USSR, Oxygen, Microbiological studies.

The influence of algae at the surface of the 'substrate-water' interface on the rate of oxidation of methane issuing from the substrate was studied experimentally. It was shown that when methane-oxidizing bacteria are supplied with mineral, nitrogen algae promote methane oxidation by acting as oxygen producers. (Author's abstract)
W87-08712

GROWTH AND SURVIVAL OF GIANT RAGWEED (AMBROSIA TRIFIDA L.) IN A DELAWARE RIVER FRESHWATER TIDAL WETLAND,
Rutgers Univ., Camden, NJ. Dept. of Biology.
F. A. Sickels, and R. L. Simpson.
Bulletin of the Torrey Botanical Club, Vol. 112, No. 4, p 368-375, October-December 1985. 6 fig, 2 tab, 30 ref.

Descriptors: *Limnology, *Ragweed, *Delaware River, *Tidal areas, *Wetlands, Growth, Survival, Aquatic plants, Biomass, Macrophytes.

The survivorship, phenology, production, and distribution of the annual species Ambrosia trifida L. in a Delaware River freshwater tidal wetland were studied during 1982. Germination began in mid April with maximum seedling density (x = 104.5, S.D. = + or - 58.1/sq m) reached in mid May. Survivorship exceeded 92% through June and then declined gradually to 23% by late September. Flowers were initiated in late July with seeds ripening in September. Maximum height (298.8 + or - 33.7 cm/plant) was attained in late September as was maximum shoot (73.8 + or - 45.6 g/plant) and root (32.7 + or - 37.0 g/plant) biomass. Peak standing crop (3265.6 g/sq m shoot and 1500.9 g/sq m root) occurred in late August. Leaf mortality was 162.1 g/sq m. Net production corrected for leaf loss and survivorship was 6573.8 g/sq m, the highest rate of production yet reported for a freshwater tidal wetland macrophyte. Seed production, estimated in late September, was 12,958 seeds/sq m with 17% showing signs of predation; apparent survival was 1% based on maximum seedling density. Transplant experiments showed that Ambrosia seedlings survived to reproduce in two locations, its normal levee habitat and near the upland forest border, a habitat isolated from a seed source. Transplants did not survive in the stream channels, apparently due to scouring and length of inundation or in the poorly drained high marsh due to lack of tolerance of seedlings to water-logged soils and to shading by other species. Thus, although Ambrosia trifida can dominate the levee habitat, its colonization of other habitats seems doubtful. (Author's abstract)
W87-08714

VEGETATION OF THE LOW-SHRUB BOGS OF NORTHERN NEW JERSEY AND ADJACENT NEW YORK: ECOSYSTEMS AT THEIR SOUTHERN LIMIT,
Bergen Community Coll., Paramus, NJ. Div. of Natural Sciences and Mathematics.
L. M. Lynn, and E. F. Karlin.
Bulletin of the Torrey Botanical Club, Vol. 112, No. 4, p 436-444, October-December 1985. 1 fig, 2 tab, 16 ref.

Descriptors: *Species composition, *Limnology, *Bogs, *Peatlands, Population dynamics, New York, New Jersey, Shrubs, Vegetation.

The vegetation of six low-shrub bogs located near the glacial boundary was quantified using phytosociological methods. Based on pH and Ca ion concentrations, these peatlands were all weakly minerotrophic to ombrotrophic systems. The dominant vascular species were Chamaedaphne calyculata, Decodon verticillatus, Kalmia angustifloia and Vaccinium corymbosum. A number of plant species which are characteristic of northern peatlands and which reach their southern distributional limit in the study region were absent from the low-shrub bogs studied, although Andromeda glaucophylla and Kalmia polifolia were present. Several species were also present in all of the study sites which are not usually found in low-shrub bogs located further north. (Author's abstract)
W87-08715

HEAVY METAL POLLUTION IN THE PARAIBA DO SUL RIVER, BRAZIL,
Universidade Federal do Rio de Janeiro (Brazil). Inst. de Biofisica.
For primary bibliographic entry see Field 5B.
W87-08718

NATURE OF ORGANIC MATTER IN RIVERS WITH DEEP SEA CONNECTIONS: THE GANGES-BRAHMAPUTRA AND INDUS,
Hamburg Univ. (Germany, F.R.). SCOPE/UNEP International Carbon Unit.
V. Ittekkot, S. Safiullah, and R. Arain.
The Science of the Total Environment STENDL, Vol. 58, No. 1/2, p 93-107, December 1986. 14 fig, 1 tab, 31 ref.

Descriptors: *River flow, *Sediments, *Limnology, *Ganges River, *Indus River, Seasonal variation, Asia, India, Organic matter.

Tropical seas receive the bulk of the annual water and sediment discharged from the land to the sea via rivers. A significant part of it comes from the major Asian rivers with direct connections to the deep sea. Within the framework of the ongoing SCOPE/UNEP World River Program we have examined the detailed nature and seasonal variability of organic matter in the Ganges, Brahmaputra and Indus rivers. Our results show that tropical seas, such as the Bay of Bengal and the Arabian Sea, receive large quantities of land-derived organic matter, both in the dissolved and the particulate phases, which has already undergone significant biogeochemical alteration on land. The relative stability and low nutritive value of this material enable its accumulation in the deep sea water column and sediments. (Author's abstract)
W87-08721

HEAVY METALS IN LAKE KINNERET (ISRAEL): II. HYDROGEN SULFIDE DEPENDENT PRECIPITATION OF COPPER, CADMIUM, LEAD AND ZINC,
Bayreuth Univ. (Germany, F.R.). Dept. of Hydrology.
T. Frevert.
Archiv fuer Hydrobiologie AHYBA4, Vol. 109, No. 1, p 1-24, March 1987. 6 fig, 3 tab, 29 ref.

Descriptors: *Lake Kinneret, *Limnology, *Water chemistry, *Hydrogen sulfide, *Heavy metals,

*Copper, *Cadmium, *Lead, *Zinc, Sulfides, Sediments.

Heavy metal interchange experiments with natural sediment-water systems from the northern and southern part of Lake Kinneret have been carried out under constant temperature, pH2S and pH feedback controlled conditions at the sediment surface and in the overlying water, respectively. For sensoring pH2S(H2S concentrations) a potentiometric glass/Ag2S semi-microelectrode cell without liquid junction was used being placed into the sediment-water interface position. H2S (pH2S) was also measured in the overlying water. Certain proportions of heavy metal solutions (ZnCl2, CdCl2, PbCl2, CuCl2) have been added stepwise into the overlying water and the subsequent uptake or release has been observed by DPASV analyses. When anoxic pH values and H2S concentrations, as were found in situ in the lake, were regulated the added metals were immediately removed from the solution, particulated and probably precipitated as MeSx.aq complexes into the sediment. Particularization was greatest with Zn and least with Cd. After re-aeration Zn was most rapidly, Pb and Cu only slowly (the latter mostly in particulate fraction) released from the sediment. It is concluded that, assuming similar mechanisms in the lake during its annual oxic-anoxic cycling, Cu and Zn should rapidly be fixed into the sediment during summer stagnation; unlike Zn, Cu will only be released after longterm oxic conditions are established at the sediment-water interface. It is consequently evidenced that the sediment may contribute to the pelagial metal concentrations after winter overturn of the lake. (Author's abstract)
W87-08761

DISTRIBUTION AND RELATIVE ABUNDANCE OF THE NILE PERCH (LATES NILOTICUS (L.) PISCES: CENTROPOMIDAE) IN LAKE KAINJI, NIGERIA,
Kainji Lake Research Inst., New Bussa (Nigeria).
J. K. Balogun.
Archiv fuer Hydrobiologie AHYBA4, Vol. 109, No. 1, p 25-38, March 1987. 6 fig, 3 tab, 20 ref.

Descriptors: *Lakes, *Limnology, *Population dynamics, *Lake Kainji, *Perch, Biomass, Spatial variation, Distribution, Fish, Reservoirs.

The spatial distribution and relative abundance of Lates niloticus before and after the impoundment is discussed. L. niloticus, a freshwater species and the only member of the Centropomidae in Kainji occupies all stretches of River Niger and the lake. Along the inshores juveniles of Lates have preferential habitats of wooded creeks where the bottom is muddy, rocky with gravels and of shallow (< 10 m) inshores with emergent vegetation while the large sized lates are frequently obtained from stretches of inflow deep water and in regions of medium to large depth (> 10 m). The impact of the impoundment brought the low population of Lates next in abundance to the Citharinidae and the Characidae in 1969 (shortly after the closure) and thereafter the gill-net catch records have pushed the Centropomidae far behind on the list of abundant fish species with fluctuating population size in Kainji Lake. However, the experimental gill-netting proves more rewarding during the low water level period (May-September) than any other period of the year. (Author's abstract)
W87-08762

LAKE EFFECT ON STREAM LIVING BROWN TROUT (SALMO TRUTTA),
Dept. of the Environment, Kristiansand S (Norway).
O. Haraldstad, B. Jonsson, O. T. Sandlund, and T. A. Schei.
Archiv fuer Hydrobiologie AHYBA4, Vol. 109, No. 1, p 39-48, March 1987. 4 fig, 2 tab, 18 ref.

Descriptors: *Lakes, *Limnology, *Trout, *Nutrients, *Fish behavior, Growth, Population dynamics, Streams, Norway, Diets, Food habits.

The effects on brown trout caused by nutrient rich lake water in outlet streams were studied by comparing feeding, growth, density, and wintering of trout living in streams running into and out of lakes in two Norwegian water courses. In the outlet streams zooplankton and filter feeders were important food items, whereas in the inlet streams, surface insects were the most important food during the ice-free season. In the Osen water course, where migration between outlet stream and lake was prevented, fish growth and density was higher in the outlet than in the inlet stream. In the Voss river course, where the trout freely migrated between outlet, lake, and inlets, the trout density was higher in the outlet than in the inlet streams, especially during winter. No growth differences were observed. (Alexander-PTT)
W87-08763

LIFE CYCLES OF FOUR SPECIES OF BAETIS (EPHEMEROPTERA) IN THREE DANISH STREAMS,
Copenhagen Univ. (Denmark). Freshwater Biological Lab.
J. Thorup, T. M. Iversen, N. O. Absalonsen, T. Holm, and J. Jessen.
Archiv fuer Hydrobiologie AHYBA4, Vol. 109, No. 1, p 49-65, March 1987. 6 fig, 1 tab, 40 ref.

Descriptors: *Life cycle studies, *Baetis, *Reproduction, *Streams, Limnology, Eggs, Larvae, Cohorts, Spatial variation.

The study of life cycles of Baetis rhodani, B. niger, B. vernus and B. fuscatus revealed two different patterns of life cycles. B. rhodani and B. niger had a life cycle with one or two winter and summer cohorts, whereas B. vernus and B. fuscatus had up to three summer cohorts and no winter cohort. The life cycle patterns reflected different strategies adapted to streams of different environmental stability and secured large egg or larval populations to be built up before the winter. Number of cohorts varied within years and localities and probably reflected variations in environmental conditions during egglaying or egghatching. (Author's abstract)
W87-08764

BENTHIC MACROINVERTEBRATES OF THE MEUSE RIVER IN BELGIUM: A REVIEW OF FIVE YEARS OF RESEARCH (1980-1984) (LES MACROINVERTEBRES BENTHIQUES DE LA MEUSE BELGE: BILAN DE CINQ ANNEES DE RECHERCHES (1980 A 1984),
Facultes Universitaires Notre-Dame de la Paix, Namur (Belgique). Unite d'Ecologie des Eaux Douces.
For primary bibliographic entry see Field 5C.
W87-08765

THREE DAY STUDY OF THE DIEL BEHAVIOUR OF PLANKTON IN A HIGHLY HUMIC AND STEEPLY STRATIFIED LAKE,
Helsinki Univ. (Finland). Lammi Biological Station.
L. Arvola, K. Salonen, R. I. Jones, A. Heinanen, and I. Bergstrom.
Archiv fuer Hydrobiologie AHYBA4, Vol. 109, No. 1, p 89-106, March 1987. 14 fig, 2 tab, 24 ref.

Descriptors: *Lakes, *Limnology, *Plankton, *Humic lakes, Epilimnion, Temporal variation, Primary productivity, Light intensity.

The diel interactions between the vertical distribution of different plankton components and the physical and chemical characteristics of water were studied through three consecutive diel cycles (54 h) in a highly humic and steeply stratified small lake. The density of bacterioplankton in the epilimnion showed little diurnal fluctuation. Some phytoplankton, particularly cryptomonads, exhibited clear diurnal migration. The diel productivity of phytoplankton closely followed the fluctuations in illumination. However, in terms of chlorophyll and illumination primary productivity was highest early in the morning. In the zooplankton, a rotifer Polyarthra was present in the epilimnion by day and descended to deeper layers by night, whereas the cladoceran, Holopedium, had an opposite migration pattern with a subsurface maximum at night. The Cladocerans Bosmina and Daphnia may have migrated horizontally. In general the diel patterns found in the plankton showed consistency over the 3 successive diel cycles. This reflected the high degree of stability in the main forcing environmental variables, especially light intensity. (Author's abstract)
W87-08766

PATTERN OF ORGANIC MATTER PRODUCTION BY NATURAL PHYTOPLANKTON POPULATION IN A EUTROPHIC LAKE 1. INTRACELLULAR PRODUCTS,
Nagoya Univ. (Japan). Water Research Inst.
T. Hama, and N. Handa.
Archiv fuer Hydrobiologie AHYBA4, Vol. 109, No. 1, p 107-120, March 1987. 5 fig, 3 tab, 19 ref.

Descriptors: *Eutrophic lakes, *Organic matter, *Phytoplankton, *Photosynthesis, Cyanophyta, Carbohydrates, Productivity, Proteins, Lipids, Incubation.

Photosynthetic products of natural phytoplankton population dominated by blue-green alga, Microcystis aeruginosa, was determined by long- and short-term incubations. Carbohydrates were the main photosynthetic products and they accounted for 72% of the total daily production. The comparison of photosynthetic products determined by long- and short-term incubations revealed that long-term incubation reflected the net production rate, whereas the value determined by short-term incubation was close to gross production rate. The specific production rate of carbohydrates was higher than proteins and lipids in daytime, however, almost equal values were obtained after 24 h incubation through day and night time. This balanced production of organic matter was due to the exclusive loss of carbohydrates in nighttime. (Author's abstract)
W87-08767

BACTERIA AS STRUCTURING AGENTS IN LAKES: FIELD MANIPULATIONS WITH BACTERIOPLANKTON,
Ottawa Univ. (Ontario). Dept. of Biology.
R. Newhook, and F. Briand.
Archiv fuer Hydrobiologie AHYBA4, Vol. 109, No. 1, p 121-138, March 1987. 6 fig, 2 tab, 50 ref.
NSERC Grant A 3011.

Descriptors: *Bacteria, *Bacterioplankton, *Lakes, *Field tests, Biomass, Nutrients, Algae, Diatoms, Cyanophyta, Reproduction, Species composition.

To investigate the possible role of bacteria in controlling the composition of plankton communities, we experimentally enriched large enclosures suspended in Heney Lake, Quebec, with cultures of the indigenous bacteria Aeromonas hydrophila anaerogenes and Serratia marcescens. Accidentally low levels of enrichment (5% of total densities) produced striking increases in the biomass of net phytoplankton (> 30 micron), perhaps as added bacteria preferentially associated with, and regenerated nutrients for, the larger algae. Diatom enhancement was particularly strong, likely reflecting bacterial interference with allelopathic substances released by blue-green algae. Phytoplankton stimulation in turn raised the levels of epilimnetic oxygen, and lowered those of ammonia. Bactivorous and carnivorous zooplankton were significantly increased in those enclosures where the added bacteria apparently reproduced best. Plankton species composition was most sensitive to bacterial additions when the pelagic community approached a steady state with regard to relative abundance. At such times, the bacteria studied were involved not just in recycling nutrients, but also mediated higher-order interactions. (Author's abstract)
W87-08768

METHOD FOR MEASURING SELECTIVE LIGHT ATTENUATION WITHIN A PERIPHYTIC COMMUNITY,
Amsterdam Univ. (Netherlands). Vakgroep Aquatische Oecologie.
For primary bibliographic entry see Field 7B.
W87-08769

1986 LAKE NYOS GAS DISASTER IN CAMEROON, WEST AFRICA,
Duke Univ., Durham, NC. Dept. of Zoology.
G. W. Kling, M. A. Clark, H. R. Compton, J. D. Devine, and W. C. Evans.
Science SCIEAS, Vol. 236, No. 4798, p 169-175, April 1987. 6 fig, 1 tab, 37 ref.

Descriptors: *Lake Nyos, *Disasters, *Cameroon, *Gas release, *Carbon dioxide, *Limnology, Lakes, Hypolimnion, Volcanoes, Monitoring.

The sudden, catastrophic release of gas from Lake Nyos on 21 August 1986 caused the deaths of at least 1700 people in the northwest area of Cameroon, West Africa. Chemical, isotopic, geologic, and medical evidence support the hypotheses that (i) the bulk of gas released was carbon dioxide that had been stored in the lake's hypolimnion, (ii) the victims exposed to the gas cloud died of carbon dioxide asphyxiation, (iii) the carbon dioxide was derived from magmatic sources, and (iv) there was no significant, direct volcanic activity involved. The limnological nature of the gas release suggests that hazardous lakes may be identified and monitored and that the danger of future incidents can be reduced. (Author's abstract)
W87-08780

QUALITATIVE MODEL OF EUTROPHICATION IN MACROPHYTE LAKES,
Academy of Sciences, Moscow (USSR). Lab. of Mathematical Ecology.
A. A. Voinov, and A. P. Tonkikh.
Ecological Modelling ECMODT, Vol. 35, No. 3/4, p 211-226, March 1987. 8 fig, 7 ref.

Descriptors: *Limnology, *Eutrophication, *Aquatic plants, *Phytoplankton, *Macrophytes, *Model studies, *Lakes, Ecosystems, Mathematical equations, Mathematical studies, Mathematical models, Dynamics, Nutrients, Detritus, Dissolved oxygen, Differential equations, Succession, Ecology, Vegetation.

A model is proposed for a qualitative representation of ecosystem dynamics in a macrophyte water body. The model variables are the concentrations of phytoplankton, macrophytes, nutrients, detritus and dissolved oxygen. By methods of qualitative theory of differential equations the model steady-state dynamics were studied (the 'quasi-stationary' process). The resulting evolution of the water body is in good agreement with the existing ideas about the succession of vegetation types under increasing nutrient load. (Author's abstract)
W87-08785

ECOLOGICAL MODELLING OF A HIGH MOUNTAIN RESERVOIR IN RELATION TO PARTICULATE ORGANIC MATTER LOADING,
Savoie Univ., Chambery (France). Lab. de Biologie.
G. Blake, and S. Gentil.
Ecological Modelling ECMODT, Vol. 35, No. 3/4, p 227-247, March 1987. 12 fig, 4 tab, 13 ref.

Descriptors: *Limnology, *Reservoirs, *Oligotrophic lakes, *Organic loading, *Model studies, Ecology, Organic matter, Mathematical equations, Mathematical studies, Mathematical models, Phosphorus, Nitrogen, Carbon, Phytoplankton, Aquatic plants, Model testing.

The modelling study of a high mountain reservoir is presented. The model has twelve state variables describing inorganic, dissolved organic and particulate phosphorus, nitrogen and carbon, together with two phytoplankton families. This oligotrophic system is shown to be very dependent on its environment and very precarious; volumetric variations and loading are the factors explaining its behavior. An original hypothesis about particulate organic carbon decomposition was made to obtain a good fit between measurements and model outputs. This hypothesis is confirmed by supplementary laboratory and in-situ experiments. (Author's abstract)
W87-08786

CATCHMENT EFFECTS ON THE HORIZONTAL DISTRIBUTION OF PHYTOPLANKTON IN FIVE OF SCOTLAND'S LARGEST FRESHWATER LOCHS,
Institute of Terrestrial Ecology, Edinburgh (Scotland).
D. G. George, and D. H. Jones.
Journal of Ecology JECOAB, Vol. 75, No. 1, p 43-59, March 1987. 9 fig, 4 tab, 39 ref.

Descriptors: *Limnology, *Phytoplankton, *Lakes, *Catchment basins, *Distribution patterns, Distribution, Horizontal distribution, Scotland, Loch Morar, Loch Ness, Loch Shiel, Loch Awe, Loch Lomond, Surface water, Temperature, Model studies, Mathematical equations, Advection, Conductivity, Chlorophyll a, Fluorescence, Growth rates, Plant growth.

Lochs Morar, Ness, Shiel, Awe and Lomond were each visited on three occasions, when horizontal variations in surface temperature, conductivity and chlorophyll a fluorescence were measured along transects running the length of each loch. The dominant species of phytoplankton behaved as passive tracers of the physical flow. Large scale (>5 km) patches of phytoplankton were produced by local differences in growth rate and not by wind-induced water movements. In all the lochs, the development of phytoplankton patchiness was directly related to the development of chemical patchiness as measured by conductivity. The potential for chemical patchiness could, in turn, be related to geological and land-use differences between the sub-catchments surrounding each loch. Some theoretical models of patch formation by differential production are discussed and used to demonstrate the importance of advective rather than diffusive processes in inland waters. The relative importance of catchment and hydraulic effects on the horizontal distribution of phytoplankton in the five lochs is discussed. (Author's abstract)
W87-08790

COMPARISON OF PARASITE FAUNA OF JUVENILE SOCKEYE SALMON (ONCORHYNCHUS NERKA) FROM SOUTHERN BRITISH COLUMBIAN AND WASHINGTON STATE LAKES,
Department of Fisheries and Oceans, Nanaimo (British Columbia). Pacific Biological Station.
R. E. Bailey, and L. Margolis.
Canadian Journal of Zoology CJZOAG, Vol. 65, No. 2, p 420-431, February 1987. 3 fig, 5 tab, 28 ref.

Descriptors: *Lakes, *Limnology, *Fish, *Salmon, *Parasites, Fauna, Aquatic animals, British Columbia, Canada, Washington State, Comparison studies, Statistical analysis, Distribution patterns.

Sixteen species and juveniles of four taxa of parasites (Myxosporea, 4; Monogenea, 1; Trematoda, 5; Cestoda, 4; Nematoda, 2; Acanthocephala, 2; Copepoda, 2) were encountered in 1550 sockeye salmon (Oncorhynchus nerka) smolts and presmolts examined from 15 Fraser River lakes, Nimpkish Lake on Vancouver Island, and Lake Washington, Washington State, USA. The most common taxa were Diphyllobothrium sp. plerocercoids, Philonema agubernaculum, Eubothrium sp., and Proteocephalus sp. Various statistical techniques (K-nearest neighbor and cluster analyses based on Jaccard and percent dissimilarity matrices) were used to compare the parasite fauna in sockeye from the different lakes. K-nearest neighbor analysis demonstrated that considerable overlap existed among many of the studied lakes, whereas little overlap occurred among other lakes. Cluster analysis revealed similar faunas among some lakes within biogeoclimatic zones and lakes of similar trophic status. Cluster analyses also revealed parasites that tended to co-occur. Parasites with similar modes of transmission or geographic range tended to cluster together. (Author's abstract)
W87-08792

SALINITY DURING EMBRYONIC DEVELOPMENT INFLUENCES THE RESPONSE TO SALINITY OF GASTEROSTEUS ACULEATUS L. (TRACHURUS),
Laval Univ., Quebec. Dept. de Biologie.
G. Belanger, H. Guderley, and G. J. FitzGerald.
Canadian Journal of Zoology CJZOAG, Vol. 65, No. 2, p 451-454, February 1987. 3 fig, 1 tab, 12 ref.

Descriptors: *Salinity, *Salt tolerance, *Water pollution effects, *Freshwater, *Fish, *Stickleback, *Fish physiology, Growth, Fish behavior, Hatching, Brackish water.

Individual male sticklebacks established nests, courted females, and cared for their fertilized eggs at 0 or 20% salinity. The time to hatching was shorter at 0 than at 20%. One-week-old fry that hatched in freshwater had a significantly lower mortality after 96 hours in freshwater than fry hatched in brackish water. Fry that hatched at 20% grew little in freshwater and had their highest growth rates at 28%, while fry that hatched at 0% showed little variation in growth rates at intermediate salinities and had reduced growth at 28%. The mean duration of fanning bouts and the total duration of fanning was significantly greater at 0 than at 20%, particularly toward the end of the incubation period, but the aggressive behavior did not differ between the two hatching salinities. (Author's abstract)
W87-08793

EFFECTS OF FOOD AVAILABILITY AND FISH PREDATION ON A ZOOPLANKTON COMMUNITY,
Illinois Univ. at Urbana-Champaign. Dept. of Ecology, Ethology and Evolution.
M. J. Vanni.
Ecological Monographs ECMOAQ, Vol. 57, No. 1, p 61-88, March 1987. 13 fig, 6 tab, 65 ref. Illinois Water Resources Center Grants S-086-ILL and S-093-ILL.

Descriptors: *Limnology, *Zooplankton, *Lakes, *Animal populations, *Predation, *Food habits, *Dynamite Lake, Food availability, *Population dynamics, Populations, Fish, Population density, Illinois, Sunfish, Nutrients.

The effects of fish predation and food availability on population densities and demography of zooplankton were investigated in Dynamite Lake, Illinois, a lake with a high density of size-selective planktivorous fish and low food levels. Fish predators (bluegill sunfish) and food levels (phytoplankton) were manipulated in replicated, factorial-design experiments during two summers (1980 and 1981). Overall, population densities of zooplankton were affected much more by manipulations of food availability than by manipulations of fish predation. Some cladocerans were greatly increased in density by elevated phytoplankton levels in both years, in the presence and absence of fish. Demographic analysis in 1981 revealed that increased densities in response to elevated food levels resulted from both an increase in birth rates and a decrease in mortality rates. Some rotifers also increased dramatically in response to elevated phytoplankton densities. Copepods were less responsive to manipulations of food levels, but several taxa exhibited increases in density in response to increased phytoplankton abundance. Few species were reduced in density by fish predation. In terms of percent change relative to controls, increased food availability had much more of an effect than fish predation on the density of most zooplankton species and on total zooplankton abundance. Fish predation had several effects on the size structure and life history traits of the cladocerans; three species attained larger sizes when fish were excluded than when fish were present. Cladoceran individuals also initiated reproduction at a smaller size and produced smaller offspring in the presence of fish. Smaller body size and size at maturity apparently allow the cladocerans to reproduce before reaching a size at which they become vulnerable to size-selective fish predators. Larger size at first reproduction and larger offspring size in the absence of fish may be a response to invertebrate predators, which assume more importance in the absence of fish and prey most heavily on the smaller size classes. Flexibility in these life-history traits allows the cladocerans to withstand what appears to be intense size-selective predation by planktivorous fish. (Author's abstract)

W87-08799

COUNTING THE DAYS ALONG LAKE MICHIGAN,
For primary bibliographic entry see Field 2J.
W87-08804

TEMPERATURE AND FLOW CONDITIONS IN A RESERVOIR WITH A SUBMERGED OUTLET TUNNEL DURING THE WINTER PERIOD,
Norwegian Water Resources and Energy Administration, Oslo.
A. M. Tvede.
Nordic Hydrology NOHYBB, Vol. 17, No. 4/5, p 399-406, 1986. 6 fig, 1 tab, 5 ref.

Descriptors: *Limnology, *Reservoirs, *Flow discharge, *Water temperature, *Tunnels, Sundsbarmvatn reservoir, Norway, Temperature, Basins, Thermocline, Epilimnion, Thermal stratification, Hypolimnion, Seasonal variation.

The Sundsbarmvatn reservoir which is used for electricity production from November to May in Norway is comprised of two main basins; water flows from the upper basin called Mannerosfjorden to the lower basin called Gullnesfjorden. The two basins are separated by a narrow sound with a sill. The regulation interval for Sundsbarmvatn is 612-574 m a.s.l., but the sill prevents Mannerosfjorden from being lowered below 580 m a.s.l. The water temperature was studied during two winters when the reservoir water was released. It was shown that a marked thermocline gradually developed at the depth of withdrawal in Gullnesfjorden. In the epilimnion layer the temperature is gradually lowered through the winter, but in the hypolimnion layer, the temperature seems to stay constant through the winter. In Mannerosfjorden, however, no clear thermocline was found at the end of the winter. The remaining water was relatively warm with temperatures mainly above 3C. The sill between the two basins has a strong influence on the depth of the water flowing out of Mannerosfjorden and hence on the temperature and circulation pattern in Gullnesfjorden. At the end of the winter this flow is strengthening and initiates a homogeneous flow layer in Gullnesfjorden. This layer dips downwards toward the outlet tunnel. For this reason the temperature of the water leaving the power station is 0.4-1.2C colder that the hypolimnion temperature in the reservoir at tunnel depth. (Author's abstract)
W87-08828

REGULATION OF SUBMERGED AQUATIC PLANT DISTRIBUTION IN A UNIFORM AREA OF A WEEDBED,
McGill Univ., Montreal (Quebec). Dept. of Biology.
M. R. Anderson, and J. Kalff.
Journal of Ecology JECOAB, Vol. 74, No. 4, p 953-961, December 1986. 1 fig, 4 tab, 48 ref.

Descriptors: *Limnology, *Ecological distribution, *Aquatic weeds, *Mesotrophic lakes, *Species composition, *Biomass, *Nutrients, *Lake sediments, *Organic matter, Sedimentology, Chemical properties, Weeds, Lakes, Environment, Aquatic environment, Sediments, Nitrogen, Phosphorus, Potassium, Ecology, Aquatic plants, Distribution.

Two uniform areas in a weedbed in a mesotrophic lake on the Quebec-Vermont border were sampled for plant biomass, species composition, sediment nutrients (N, P, and K), and organic matter to test the hypothesis that variation in submerged plant biomass and species distribution is related to variation in sediment characteristics. Total biomass and the biomass of the most abundant species were related to sediment nutrient concentrations in both areas. At 2 m depth, exchangeable P explains 28% of the variation in total biomass, while at 1 m exchangeable K explained 16% of the variation. The biomass of Heteranthera dubia is related to exchangeable K and exchangeable N at both depths. At 2 m, the two variables explain 50% of the variation in H. dubia biomass. Exchangeable P explained a small but significant amount of variation in the biomass of Valisneria americana and Myriophyllum spicatum at 2 m, while the variation in the biomass of Eriocaulon canadensis is best explained by exchangeable K at 2 m. (Author's abstract)
W87-08836

HYDROLOGY, WATER CHEMISTRY AND ECOLOGICAL RELATIONS IN THE RAISED MOUND OF COWLES BOG,
National Park Service, Porter, IN. Indiana Dunes National Lakeshore.
D. A. Wilcox, R. J. Shedlock, and W. H. Hendrickson.
Journal of Ecology JECOAB, Vol. 74, No. 4, p 1103-1117, December 1986. 7 fig, 3 tab, 54 ref.

Descriptors: *Limnology, *Bogs, *Ecology, *Cowles Bog, *Wetlands, *Peat bogs, *Groundwater hydrology, *Geohydrology, Vegetation, Indiana, Peat, Lake Michigan, Dunes, Fens, Acidity, Water level fluctuations, Hydrology, Groundwater, Test wells, Artesian pressure, Confined groundwater, Upwelling, Recharge, Groundwater recharge, Aquifers, Moraines, Clays, Soil types, Marl, Head loss, Sediments.

The ecology of Cowles Bog National Natural Landmark and the wetlands between the dunes near the south shore of Lake Michigan (Indiana) were studied. The site contains plant species that are typical of circum-neutral fens. The distribution of eight rather sharply delineated vegetation types correlates most strongly with water level variations resulting from the presence of a 4.1-ha convex peat mound. A network of shallow groundwater wells installed in the wetland identified an upwelling of water under artesian pressure at sites underlying the mound. The well-buffered water, containing high concentrations of inorganic solutes, is derived from an aquifer that is recharged on an upland moraine and is confined beneath a clay till sheet. A breach in this clay layer beneath the mound allows water to flow upward and radially outward as the hydraulic head is dissipated in the overlying marl and peat. The marl and organic lake sediments were formed 4000-6000 years ago, when the wetland basin was probably a small bay of the lake. The peat mound developed when the lake level fell. (Author's abstract)
W87-08837

PREDICTION OF THE OCCURRENCE OF FOUR SPECIES OF MOSQUITO LARVAE WITH LOGISTIC REGRESSION ON WATER-CHEMISTRY VARIABLES,
North Carolina State Univ. at Raleigh. Dept. of Statistics.
M. S. Udevitz, P. Bloomfield, and C. S. Apperson.
Environmental Entomology EVETBX, Vol. 16, No. 1, p 281-285, February 1987. 1 fig, 3 tab, 14 ref. N.C. Div. of Health Serv. Contract 820034.

Descriptors: *Limnology, *Model studies, *Prediction, *Mosquitoes, *Larval growth stage, *Regression analysis, *Chemical properties, *Species distribution, *Pools, Growth stages, Aquatic insects, Habitats, Aquatic habitats, Floodplains, Ecology, Streams, Statistical analysis.

Larvae of Anopheles punctipennis, Culex territans, Aedes atlanticus, and Psorophora ferox were collected and 13 water-chemistry variables were measured at permanent and semipermanent pools in Duplin County, NC during 1982 and 1983. Stepwise logistic regression was used to identify water-chemistry variables associated with habitats and to predict the occurrence of each species. Models based on pH and concentrations of Cl, K, and Na ions gave reasonable predictions of occurrence. However, although the logistic regression models make reasonable predictions of the occurrence of each species, pools where species actually occurred span nearly the entire range of probabilities for their predicted occurrence. It is concluded that occurrence of larvae is related to biotic and abiotic factors not considered in this investigation. Logistic regression could be used to identify these additional factors and incorporate them into models that would provide more accurate predictions of occurrence. (Author's abstract)

W87-08846

THEORY OF SECONDARY PRODUCTION CALCULATIONS FOR CONTINUOUSLY REPRODUCING POPULATIONS,
Melbourne Univ., Parkville (Australia). Dept. of Zoology.
For primary bibliographic entry see Field 2L.
W87-08862

INTERNAL WAVES OF THE SECOND VERTICAL MODE IN A STRATIFIED LAKE,
Department of the Environment, West Vancouver (British Columbia).
R. C. Wiegand, and V. Chamberlain.
Limnology and Oceanography LIOCAH, Vol. 32, No. 1, p 29-42, January 1987. 9 fig, 26 ref.

Descriptors: *Limnology, *Internal waves, *Thermal stratification, *Lakes, *Seiches, *Hydrodynamics, *Hydrothermal studies, Waves, Wind, Thermal properties, Thermocline, Mixing, Eddy diffusion, Diffusion coefficient, Isotherms, Hypolimnion, Bottom water, Turbulent flow, Flow characteristics, Boundaries, Water currents, Sediments, Bottom sediments, Bottom currents, Turbidity currents.

A time series of measurements of thermal structure and near-bottom currents in a stratified lake revealed both first and second vertical mode internal seiching. The transition into second-mode seiching occurred after first mode waves, usually generated by pulses of strong winds, died down. The major features of the second-mode seiche are described and its effects on mixing in the lake below the thermocline are discussed. On the basis of calculations of eddy diffusion coefficients, there is only weak mixing in the interior of the hypolimnion. Scaling arguments suggest that mixing at the edges of the lake due to motion of the isotherms is not significant despite the larger amplitudes of the second-mode seiche. The most important mixing region appears to be a turbulent bottom boundary layer driven by seiche currents. However, resuspension of bottom sediments did not occur, probably due to a combination of sediment nature and low current speeds. (Author's abstract)
W87-08863

STRUCTURE AND DYNAMICS OF INTERNAL WAVES IN BALDEGGERSEE,
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
U. Lemmin.
Limnology and Oceanography LIOCAH, Vol. 32, No. 1, p 43-61, January 1987. 11 fig, 1 tab, 29 ref.

Descriptors: *Internal waves, *Hydrodynamics, *Baldeggersee, Switzerland, *Seasonal variation, *Lakes, *Seiches, Temperature, Water temperature, Stratification, Thermal stratification, Waves, Wind, Energy, Spectral analysis, Model studies, Mathematical studies, Mixing, Isotherms.

Analysis of long records of temperature/depth distribution determined at 10- or 20-min intervals at several stations and extending over three stratification seasons provides a detailed picture of the characteristics, dynamics, and seasonal variation in activity of internal waves in a small lake (Baldeggersee, Switzerland). Wind stress in general was low, with occasional bursts of higher energy. The ensuing, slightly damped, internal seiches govern the dynamics of the stratified lake. The vertical structure displays a dominant response of the first vertical mode. Responses in the second vertical mode, hitherto rarely recorded, are also demonstrated using spectral analysis and models. The horizontal structure of the seiche's motion displays dominance and persistence of the fundamental basin mode. Spectral analysis also discloses responses of the second and third basin modes. Multiplying the spectra with the local buoyancy frequency leads to a collapse of all spectra into a narrow band, suggesting the possibility of a universal spectrum. It is concluded that, in this small-basin, low-energy example, internal waves provide motions at all levels, but little vertical mixing. (See also W87-08865) (Author's abstract)

W87-08864

DYNAMICS OF BOTTOM CURRENTS IN A SMALL LAKE,
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'hydraulique.
U. Lemmin, and D. M. Imboden.
Limnology and Oceanography LIOCAH, Vol. 32, No. 1, p 62-75, January 1987. 14 fig, 22 ref.

Descriptors: *Limnology, *Bottom currents, *Lakes, *Hydrodynamics, *Water currents, *Stratification, *Sediment-water interfaces, Current meters, Gages, Measuring instruments, Boundaries, Spectral analysis, Chemical stratification, Waves, Gravity waves, Thermocline, Seasonal variation, Mixing, Wind, Bottom water, Sediment transport, Interfaces.

The dynamics of bottom currents in Baldeggersee (Switzerland) were investigated with a specially designed recording current meter sensitive to current velocities of 0.3-2.5 cm/s. Supporting information was obtained from thermistor-chain temperature recordings and from records of atmospheric boundary-layer parameters measured in the center of the lake. During 1980-1981, bottom currents recorded 1-week periods on the central bottom plateau of the lake (65-m water depth) were highly variable. The mean speed was slightly > 1 cm/s with no seasonal trend. Speeds > 2.5 cm/s occurred after periods of high wind; quiescent periods were rare and seldom lasted more than 1 hr. Spectral analysis shows that the primary mechanism generating bottom currents during stratification is internal gravity waves in the thermocline. During winter mixing, when chemical stratification is observed below 30 m, the wind stress distribution is directly reflected in the bottom current pattern. In both period, wind-induced disturbances were felt in the bottom layer with little time delay, indicating the event-dominated structure of bottom current dynamics. Bursts of particle transport in the bottom layer are observed during periods of high wind, suggesting episodic particle resuspension. It is concluded that such events may be important for the control of mass exchange at the sediment-water interface. (See also W87-08864) (Author's abstract)
W87-08865

SURFACE MANIFESTATIONS OF INTERNAL OSCILLATIONS IN A HIGHLY SALINE LAKE (THE DEAD SEA),
Weizmann Inst. of Science, Rehovot (Israel). Dept. of Isotope Research.
Z. Sirkes.
Limnology and Oceanography LIOCAH, Vol. 32, No. 1, p 76-82, January 1987. 11 fig, 1 tab, 17 ref.

Descriptors: *Hydrodynamics, *Limnology, *Seiches, *Oscillatory waves, *Dead Sea, *Saline lakes, *Density stratification, *Limnology, *Seasonal variation, *Surface water, Waves, Lakes, Stratification, Density, Seiches, Mathematical models, Wind, Distribution, Diurnal distribution.

The manifestation of internal oscillations at the surface of the Dead Sea during the summer of 1981 is described. During that time, the Dead Sea was highly stratified, with a density difference of 0.017 g/l between its two layers. Measurements of lake level (limnograms) show oscillations with periods of internal seiches as confirmed by thermistor-chain measurements and a numerical model of internal oscillations. Wind measurements exhibit predominantly diurnal and semidiurnal periods. During autumn 1984, the Dead Sea turned over and its layered structure was thereby destroyed. In contrast to the measurements of summer 1981, the limnograms for this timespan show only oscillations associated with period corresponding to surface seiches, but no sign of internal oscillations. (Author's abstract)
W87-08866

CARBON ISOTOPE FRACTIONATION AND CHANGES IN THE FLUX AND COMPOSITION OF PARTICULATE MATTER RESULTING FROM BIOLOGICAL ACTIVITY DURING A SEDIMENT TRAP EXPERIMENT IN LAKE GREIFEN, SWITZERLAND,
Woods Hole Oceanographic Institution, MA.
C. Lee, J. A. McKenzie, and M. Sturm.
Limnology and Oceanography LIOCAH, Vol. 32, No. 1, p 83-96, January 1987. 8 fig, 4 tab, 49 ref. NSF Grant OCE 83-00018.

Descriptors: *Carbon radioisotopes, *Particulate matter, *Lake Greifen, Switzerland, *Lake sediments, *Eutrophic lakes, *Limnology, Radioisotopes, Carbon, Sediments, Lakes, Hardness, Chemical properties, Hydrogen ion concentration, Acidity, Oxygen, Suspended solids, Photosynthesis, Respiration, Carbon dioxide, Sedimentation, Calcite, Precipitation, Amino acids, Detritus, Organic matter, Zooplankton, Plankton, Food habits.

Sediment traps were deployed in Lake Greifen, a hard-water, eutrophic, Swiss lake, for two weeks in May and June, 1983. Oxygen, pH, and suspended particle concentrations indicated a sharp increase in productivity. Carbon isotope composition of the dissolved inorganic carbon showed possible evidence of diffusion of atmospheric CO2 across the water-atmosphere interface, most likely to replace CO2 use during photosynthesis. Allochthonous mineral debris from resuspended sediments or river input was a major component of sedimenting material. Due to removal of CO2, calcite crystals precipitated when photosynthesis increased. The carbon isotope ratio of trap calcite and the composition of trap amino acids showed the influence of the detrital input on the more dominant isotopic signal of authigenic calcite in the sediment traps, likely due to fractionation during precipitation in the surface waters or during dissolution in the water and sediments due to CaCO3 undersaturation. Extensive loss of material from unpoisoned sediment traps was found in the euphotic zone, most likely due to zooplankton feeding. (Author's abstract)
W87-08867

FREE AMINO ACIDS IN LAKES: CONCENTRATIONS AND ASSIMILATION RATES IN RELATION TO PHYTOPLANKTON AND BACTERIAL PRODUCTION,
Royal Veterinary and Agricultural University, Frederiksberg C. (Denmark). Dept. of Microbiology.
N. O. G. Jorgensen.
Limnology and Oceanography LIOCAH, Vol. 32, No. 1, p 97-111, January 1987. 5 fig, 4 tab, 52 ref. Danish Natural Science Research Council Grants 11-3308 and 11-2605.

Descriptors: *Limnology, *Amino acids, *Chemical properties, *Phytoplankton, *Primary productivity, *Lakes, *Assimilative capacity, *Aquatic bacteria, Capacity, Bacteria, Plankton, Aquatic plants,Productivity, Trophic level, Distribution, Diurnal distribution, Denmark, Statistical analysis, Carbon cycle, Eutrophic lakes.

Diel changes of concentrations and assimilation rates of dissolved free amino acids (DFAA) were followed every third day during periods of 3-5 weeks in one oligotrophic and two eutrophic Danish lakes. Concentrations of DFAA varied from 78 to 3,672 nM, with most concentrations between 200 and 1,600 nM. Diel variations of DFAA ranged from < 10% to 500%. High morning concentrations in one eutrophic lake coincided with the diel minimum bacterial production. Statistical analyses demonstrate that long-term changes of the DFAA pools in the three lakes were negatively correlated with both primary production (except the oligotrophic lake) and bacterial production. Assimilation of DFAA in the eutrophic lakes did not demonstrate diel trends, although the mean diel assimilation rates correlated negatively with primary production. No tendencies in the DFAA assimilation rates were observed in the oligotrophic lake. Carbon flux of DFAA assimilation in the lakes on the average made up from 6.9 to 11.3% of the primary production, and from 28.5 to 93.1% of the bacterial production, determined by (H3)thymidine incorporation. Data from the eutrophic lakes suggest that degradation of phytoplankton can be a major source of DFAA in lakes. (Author's abstract)
W87-08868

VERTICAL TRANSPORT OF HEAVY METALS BY SETTLING PARTICLES IN LAKE ZURICH,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5B.
W87-08869

SESTONIC BACTERIA AS A FOOD SOURCE FOR FILTERING INVERTEBRATES IN TWO SOUTHEASTERN BLACKWATER RIVERS,
Georgia Univ., Athens. Inst. of Ecology.
R. T. Edwards.
Limnology and Oceanography LIOCAH, Vol. 32, No. 1, p 221-234, January 1987. 5 fig, 5 tab, 55 ref. NSF Grants DEB 81-04427 and BSR 84-06631.

Descriptors: *Limnology, *Seston, *Aquatic bacteria, *Blackwater rivers, *Invertebrates, *Food habits, *Biomass, Bacteria, Rivers, Carbon, Georgia, Populations, Flood plains, Flooding, Aquatic insects, Insects.

Bacterial cell concentrations and biomass within seven size classes of seston in the Ogeechee River and Black Creek, two blackwater rivers in southeastern Georgia, were measured for 19 months. The proportion of sestonic carbon in bacteria was determined to assess the relative food quality of the various fractions for filtering invertebrates. Cell concentrations were unusually high in both rivers (mean 1.48 x 10 to the 10th power cells/l). Most cells were small, coccoid forms not attached to particles. Total bacterial biomass was also high, ranging from 19.1 to 1,105.0 mg C/cu m. Most of the bacterial biomass was in the particle size range from 0.30 to 12 microns. The bacterial carbon composition of the seston was < 1% in both rivers for all seston > 12 microns. Percentages in the < 12 microns fraction were much higher, ranging from 1.4 to 28.9% in Black Creek and 15.5 to 99.9% in the Ogeechee River. Cell concentrations and biomass varied with river discharge and were higher during periods of floodplain inundation. The high bacterial content of the smallest fraction of seston may be an important food source for filter-feeding invertebrates such as blackflies and chironomids, which are abundant in these rivers. (Author's abstract)
W87-08870

ROLE OF GAS EXCHANGE IN THE INORGANIC CARBON, OXYGEN, AND 222RN BUDGETS OF THE AMAZON RIVER,
Washington Univ., Seattle. School of Oceanography.
A. H. Devol, P. D. Quay, J. E. Richey, and L. A. Martinelli.
Limnology and Oceanography LIOCAH, Vol. 32, No. 1, p 235-248, January 1987. 1 fig, 6 tab, 59 ref. NSF Grant BSR 81-07522.

Descriptors: *Limnology, *Radon radioisotopes, *Carbon cycle, *Oxygen balance, *Amazon River, *Gas exchange, *Alkalinity, *Chemical properties, Radioisotopes, Rivers, Oxygen, Dissolved oxygen, Carbon dioxide, Respiration, Boundaries, Streams, Tributaries, Tracers, Radioactive tracers.

Dissolved oxygen, 222Rn, pCO2, alkalinity, respiration rate, and discharge were measured at eight mainstem and seven tributary stations during February-March 1984 in a 1,700-km stretch of the Amazon River. Air-water gas exchange rates were estimated two ways: measurements of the flux of into 222Rn floating domes yielded an average boundary layer thickness of 78 microns, and oxygen mass balance calculations resulted in an average of 38 microns. Therefore, CO2 loss to the atmosphere may be 37.4 kmol/s, roughly equal to the total tributary dissolved inorganic carbon (DIC) input (43 kmol/s) and about half the total fluvial DIC input to the section (97.7 kmol/s). Thus, CO2 evasion is a major component of Amazon River DIC balance. A quasi-steady state is maintained between respiratory input and evasion of CO2. Dissolved 222Rn activities in the mainstem varied from 3.5 to 8.3 dpm/l and were

always highly supersaturated with respect to the atmosphere. Dissolved radon was not supported by decay of 226Ra. An 222Rn mass balance indicated that direct groundwater input into this stretch of the Amazon mainstem probably accounted for no more than 1% of water discharge. (Author's abstract)
W87-08871

PHOTOSYNTHATE DISTRIBUTION BY MICROPLANKTON IN PERMANENTLY ICE-COVERED ANTARCTIC DESERT LAKES,
Montana State Univ., Bozeman. Dept. of Biology.
J. C. Priscu, L. R. Priscu, W. F. Vincent, and C. Howard-Williams.
Limnology and Oceanography LIOCAH, Vol. 32, No. 1, p 260-270, January 1987. 5 fig, 3 tab, 28 ref. NSF Grant INT 84-12682.

Descriptors: *Limnology, *Photosynthesis, *Plankton, *Iced lakes, *Antarctic, *Photosynthetic bacteria, Lakes, Polar regions, Tracers, Radioactive tracers, Radioisotopes, Carbon radioisotopes, Chlorophyll, Bacteria, Aquatic bacteria, Protein, Lipids, Algae, Ice.

The distribution of 14C-labeled photosynthate by microplankton in Lakes Vanda and Fryxell (Antarctica) was measured during the 1984-1985 austral summer. Both lakes had conspicuous deep chlorophyll maxima near the bottom of the oxygenated zone. DCMU sensitivity experiments revealed that photosynthesis below the chlorophyll maximum in Lake Fryxell was partially due to photosynthetic bacteria. These bacteria had notably higher protein and lower lipid labeling than overlying oxic microalgae. Protein labeling in the oxic microalgae had lower I sub k and higher alpha values than for other photosynthetic end products, indicating that protein is synthesized more efficiently at low photosynthetic photon flux density than the other metabolites. The I sub k values for complete photosynthesis (< 20 microEinst/sq m/s) are among the lowest yet recorded for phytoplankton. (Author's abstract)
W87-08872

ACUTE TOXICITY OF BRESTAN AND FENTIN ACETATE ON SOME FRESHWATER ORGANISMS,
For primary bibliographic entry see Field 5C.
W87-08876

ORGANOCHLORINE PESTICIDE RESIDUES IN FISH FROM THE SHATT AL-ARAB RIVER, IRAQ,
The University, Basrah (Iraq). Dept. of Environmental Marine Chemistry.
For primary bibliographic entry see Field 5B.
W87-08880

CADMIUM AND LEAD IN LAKE ONTARIO SALMONIDS,
Rochester Univ. Medical Center, NY. Dept. of Biophysics.
C. J. Cappon.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 4, p 695-699, April 1987. 1 fig, 2 tab, 12 ref. NIEHS Grant ES-01247.

Descriptors: *Limnology, *Cadmium, *Lead, *Lake Ontario, *Salmon, *Bioaccumulation, *Path of pollutants, *Tissue analysis, *Trout, *Water pollution effects, Heavy metals, Fish, Food chains, Accumulation, Spectroscopy, Atomic absorption spectroscopy, Diets, Foods, Muscle, Toxicity, Population exposure, Public health, Risks, Monitoring.

Cadmium and lead levels were studied in Lake Ontario salmonids to assess their potential human dietary intake. Analyses were conducted by graphite furnace atomic absorption spectrophotometry. Mean lead levels in coho and chinook salmon and in lake and brook trout ranged from 0.22 to 0.30 micrograms/g. Mean cadmium levels in these species ranged from 0.08 to 0.11 micrograms/g. There were no significant differences among species. Concentrations were generally higher than mean values reported for freshwater fish in the literature because of industrial effluent discharges from Eastern Lake Erie and the Niagara River. Average calculated daily human dietary intakes of cadmium and lead are 7.5 and 16.4 micrograms, or 13.1% and 3.8% of WHO/FAO provisional tolerable intakes, respectively. It is concluded that consumption of Lake Ontario salmonids will probably not result in an immediate human health hazard if done infrequently, although the relatively high cadmium levels warrant future monitoring of tissue content in salmonids from the lake. (Doria-PTT)
W87-08883

RESEARCH IN ENVIRONMENTAL POLLUTION: II. DETERMINATION OF POLYCHLORINATED NITROBENZENES (PCNB'S) IN MAIN RIVER FISH,
Hessische landwirtschaftliche Versuchsanstalt, Darmstadt (Germany, F. R.).
For primary bibliographic entry see Field 5A.
W87-08895

MATHEMATICAL MODEL OF SEASONAL AND SPATIAL VARIATION IN PHOSPHORUS CONCENTRATIONS IN LAKE MEMPHREMAGOG, QUEBEC,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W87-08899

CORRELATION OF A LAKE EUTROPHICATION MODEL TO FIELD EXPERIMENTS,
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
G. Rossi, G. Premazzi, and G. Marengo.
Ecological Modelling ECMODT, Vol. 34, No. 3/4, p 167-189, December 1986. 13 fig, 5 tab, 11 ref.

Descriptors: *Limnology, *Mathematical models, *Eutrophication, *Model testing, *Eutrophic lakes, *Lake Lugano, *Phosphorus compounds, Trophic levels, Lakes, Bays, Sampling, Phosphorus, Epilimnion, Stratification, Wastewater treatment, Water pollution effects, Prediction, Phosphates, Oxygen balance, Biomass, Algae.

A vertical box interaction model is applied to a bay of the highly eutrophic Lake Lugano on the Italian-Swiss border in order to interpret data obtained in the field in 1981. The phosphorus cycle in the epilimnion during summer stratification and the role played by the organic P components (dissolved and particulate) in the regeneration process is discussed. The operation of a wastewater treatment plant discharging into the bay has increased the concentration significance of the organic dissolved P form in the bay, raising the problem of its biological availability. The procedure consisted of assessing the transfer coefficients among the various Pl forms by means of comparisons between calculated evolution and measured average summer value of the related epilimnetic concentrations. The proposed correlation allows an evaluation of the mean residence time of P in the various compartments and total P turnover in the ecosystem. A predictive use of the model simulating a reduction of P loading is also described. (Author's abstract)
W87-08900

SEASONALITY OF LEGIONELLA ISOLATES FROM ENVIRONMENTAL SOURCES,
South African Institute for Medical Research, Johannesburg. Dept. of Medical Microbiology.
L. Tobiansky, A. Drath, B. Dubery, and H. J. Koornhof.
Israel Journal of Medical Sciences IJMDAI, Vol. 22, No. 9, p 640-643, September 1986. 3 tab, 20 ref.

Descriptors: *Limnology, *Water pollution sources, *Seasonal variation, *South Africa, *Legionella, *Potable water, *Cooling water, *Lakes, *Microbiological studies, *Isolation, Sampling, Sample preparation, Filtration, Membrane filtration, Bacteria, Pathogenic bacteria, Diseases, Human diseases, Chemical properties, Culturing techniques, Epidemiology, Ecology.

Results of environmental specimens were reviewed to determine whether the presence of Legionella in the environment parallels the seasonality of clinical cases in South Africa, where occurrence of the disease peaks in late summer and autumn (November to May). Samples were collected of potable, domestic hot and cold, cooling, and environmental water. Of 343 samples, 109 (61.5%) of the summer-autumn samples and 77 (46.4%) of winter-spring samples were Legionella-positive by the direct fluorescent antibody technique. Results indicate that, although Legionella spp. are present in environmental water during the cooler months, they cannot readily be cultured. It is postulated that, during the winter-spring period, the legionellae undergo a period of nutrient stress, during which time they remain viable but cannot be cultured. (Author's abstract)
W87-08902

SEASONAL DISTRIBUTION OF LEGIONELLAE ISOLATED FROM VARIOUS TYPES OF WATER IN ISRAEL,
Hebrew Univ.-Hadassah Medical School, Jerusalem (Israel). Dept. of Clinical Microbiology.
For primary bibliographic entry see Field 5A.
W87-08903

EFFECT OF MOSQUITO KILLER INSECTICIDES ON FRESHWATER MUSSELS,
Balaton Limnological Research Inst., Tihany (Hungary).
For primary bibliographic entry see Field 5C.
W87-08908

CONTAMINATION OF FISH FROM THE FRENCH ZONE OF LAKE LEMAN BY ORGANOCHLORINE COMPOUNDS BETWEEN 1973 AND 1981 (CONTAMINATION DES POISSONS DU SECTEUR FRANCAIS DU LAC LEMAN, PAR LES COMPOSES ORGANOCHLORES ENTRE 1973 ET 1981),
Ministere de l'Agriculture, Paris (France). Laboratoire Central d'Hygiene Alimentaire.
A. Venant, and G. Cumont.
Environmental Pollution, Vol. 43, No. 3, p 163-173, March 1987. 1 fig, 3 tab, 11 ref.

Descriptors: *Path of pollutants, *Limnology, *Water pollution effects, *Contamination, *Lake Leman, France, *Chlorinated hydrocarbons, *Tissue analysis, *Fish, *Bioaccumulation, Perch, Roach, Polychlorinated biphenyls, Agricultural chemicals, Water pollution sources, Pollutant identification, Muscle, Lindane, Heptachlor, Aldrin, Dieldrin, DDT, Pesticides, Organic pesticides, Halogenated pesticides, Insecticides, Hydrocarbons, Accumulation.

Fish taken from the French zone of Lac Leman at Thonon-les-Bains were sampled for organochlorine pesticides and PCBs. Trends in organochlorine contamination in muscle of Perca fluviatilis and Rutilus rutilus are presented for 1973-1981, showing low levels of the chemicals. All values are lower than the maximum acceptable residue limits set by several countries for fish for human consumption; many were below detection limits. Results are consistent with published studies. (Doria-PTT)
W87-08909

RESIDUES OF ORGANOCHLORINE PESTICIDES IN ENVIRONMENTAL SAMPLES FROM THE SHATT-AL-ARAB RIVER, IRAQ,
Basrah Univ. (Iraq). Marine Science Center.
For primary bibliographic entry see Field 5B.
W87-08910

ASBESTOS FIBRES INTRODUCE TRACE METALS INTO STREAMWATER AND SEDIMENTS,
British Columbia Univ., Vancouver. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W87-08912

ALGAL PHAGOTROPHY: REGULATING FACTORS AND IMPORTANCE RELATIVE TO PHOTOSYNTHESIS IN DINOBRYON (CHRYSOPHYCEAE),
McGill Univ., Montreal (Quebec). Dept. of Biology.
D. F. Bird, and J. Kalff.
Limnology and Oceanography LIOCAH, Vol. 32, No. 2, p 277-284, March 1987. 5 fig, 1 tab, 39 ref.

Descriptors: *Algae, *Lakes, *Algal phagotrophy, *Limnology, *Photosynthesis, *Chrysophyta, *Nutrients, Bacteria, Grazing, Temperature, Light quality, Quebec.

Simultaneous measurements of inorganic carbon fixation and phagotrophic particle uptake by Dinobryon in a metalimnetic algal abundance peak showed that this alga depended more strongly on ingested bacteria for nutrition than on photosynthesis. Measurements of the grazing rate at different depths in Lac Gilbert, Quebec, showed that the particle ingestion rate depends on water temperature rather than light availability. Phagocytosis of bacteria proceeded at a similar rate both day and night in most lakes where Dinobryon was found. Since other chrysomonad genera (Chrysophaerella, Uroglena, Catenochrysis, Ochromonas, Chromulina, and Chrysococcus) were also found to ingest particles, it will not be possible to estimate grazing on bacteria by counting nonpigmented cells and ignoring those containing chlorophyll. In oligotrophic Lac Bowker, 30% of the phytoplankton cells were actively ingesting small particles, and it was these phytoplankton and not the less numerous zooplankton that were responsible for most bacterial grazing in the lake. Phagotrophy by algae appears to be an important but unexpected pathway for energy flow in lakes. (Author's abstract)
W87-08929

ECOLOGY OF A CRYPTOMONAS PHASEOLUS POPULATION FORMING A METALIMNETIC BLOOM IN LAKE CISO, SPAIN: ANNUAL DISTRIBUTION AND LOSS FACTORS,
Autonomous Univ. of Barcelona (Spain). Dept. of Microbiology.
C. Pedros-Alio, J. M. Gasol, and R. Guerrero.
Limnology and Oceanography LIOCAH, Vol. 32, No. 2, p 285-298, March 1987. 9 fig, 40 ref.

Descriptors: *Cryptomonas, *Eutrophication, *Lake Ciso, *Limnology, *Population dynamics, Lakes, Spain, Sulfides, Metalimnion, Light quality.

Cryptomonas phaseolus was present throughout the water column during holomixis in Lake Ciso (Spain), despite the presence of sulfide. During stratification, C. phaseolus formed a layer with abundances up to 100,000 cells/ml at the metalimnion, where oxygen and sulfide were present simultaneously at low concentrations. Light at this depth was between 1 and 20% of surface incident radiation. Loss factors were studied during 2 years. Outwash was negligible most of the year, but could reach 30% of total losses during certain short periods in winter. Cryptomonas phaseolus was found to sink with speeds up to 55 cm/d, which is in accord with velocities calculated with Stokes' law. There was a single sedimentation peak in spring accounting for 40-60% of total losses. Decomposition was the most important loss factor for most of the year. Cryptomonas phaseolus cells were always actively growing, but losses balanced production for most of the study period. Average cell volume increased during mixing and decreased during stratification. Doubling times were minimal (7 d) in March at the onset of stratification and slowly increased through spring and summer, reaching a maximum just before mixing (around 50 d) and decreasing again through winter until the next March minimum. (Author's abstract)
W87-08930

SIMULTANEOUS MEASUREMENT OF PRIMARY PRODUCTION BY WHOLE-LAKE AND BOTTLE RADIOCARBON ADDITIONS,
Lamont-Doherty Geological Observatory, Palisades, NY.
P. M. Bower, C. A. Kelly, E. J. Fee, J. A. Shearer, and D. R. DeClercq.
Limnology and Oceanography LIOCAH, Vol. 32, No. 2, p 299-312, March 1987. 3 fig, 6 tab, 38 ref.
NSF Grants DAR 79-17291 and DEB 80 17639.

Descriptors: *Isotope studies, *Limnology, *Analytical methods, *Primary productivity, *Carbon isotopes, Organic matter, Sedimentation, Lakes, Model studies, Light quality.

Three additions of inorganic 14C were made during midsummer to the mixed layers of two small lake basins in northwestern Ontario. The incorporation of this 14C into organic matter was monitored, and the resulting rates of daily primary production measured in the open water were compared with those derived from bottles incubated both in the laboratory and in situ. Sedimentation of particulate 14C, regeneration of inorganic 14C from organic 14C fixed on previous days, and time scale were examined as potentially important ways in which the whole-lake method differed from bottle incubations. Daily production estimates derived from laboratory incubations and a numerical model agreed well with whole-lake values. In situ bottle measurements that were analyzed in the standard way consistently underestimated whole-lake values, primarily because of the assumption that solar irradiance (I) is linearly related to integral production (P). Investigators without access to a controlled-light incubator could increase the accuracy of their daily production estimates by calculating P vs. I curves from their in situ production data and analyzing them with the numerical model. (Author's abstract)
W87-08931

SEDIMENTATION AND BIOTURBATION IN A SALT MARSH AS REVEALED BY 210PB, 137CS, AND 7BE STUDIES,
South Carolina Univ., Columbia. Dept. of Geology.
For primary bibliographic entry see Field 2L.
W87-08932

RESUSPENSION IN THE SHALLOW SUBLITTORAL ZONE OF A MACROTIDAL ESTUARINE ENVIRONMENT: WIND INFLUENCE,
Ministere des Peches et des Oceans (Quebec). Inst. Maurice-Lamontagne.
For primary bibliographic entry see Field 2L.
W87-08933

ABSORPTION OF LIGHT BY YELLOW SUBSTANCE IN FRESHWATER LAKES,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
R. J. Davies-Colley, and W. N. Vant.
Limnology and Oceanography LIOCAH, Vol. 32, No. 2, p 416-425, March 1987. 5 fig, 1 tab, 40 ref.

Descriptors: *Spectrophotometry, *Light absorption, *Freshwater lakes, *Yellow substance, Analytical methods, Spectral analysis, Mathematical equations, Absorption, Wavelengths, Model studies.

A spectrophotometric study was made of the absorption of light by yellow substance (gilvin, gelbstoff) in 12 freshwater lakes of diverse optical and biochemical character in which concentrations of yellow substance ranged 50-fold. The shapes of the spectra of yellow substance absorption, g sub lambda, suitably corrected for residual light scattering in the spectrophotometer, were well described by an exponential function of wavelength, lambda, at near-UV to visible wavelengths: g sub lambda = g sub R (exp(S(R - lambda))), in which R is a reference wavelength and S is the characteristic exponential slope parameter. The average value of S was 0.0187/nm, somewhat higher than previous workers have found in seawaters and other freshwaters. Absorption coefficients of yellow substance at reference-visible wavelengths (e.g. 440 nm) can be predicted within about + or - 15% from near-UV absorption measurements with the exponential model of spectral shape. (Author's abstract)
W87-08934

PHOTOSYNTHESIS AND LIGHT ADAPTATION IN EPIPHYTE-MACROPHYTE ASSOCIATIONS MEASURED BY OXYGEN MICROELECTRODES,
Copenhagen Univ. (Denmark). Freshwater Biological Lab.
For primary bibliographic entry see Field 7B.
W87-08935

THYMIDINE INCORPORATION AND MICROBIAL RESPIRATION IN THE SURFACE SEDIMENT OF A HYPEREUTROPHIC LAKE,
Uppsala Univ. (Sweden). Inst. of Limnology.
R. T. Bell, and I. Ahlgren.
Limnology and Oceanography LIOCAH, Vol. 32, No. 2, p 476-482, March 1987. 1 fig, 3 tab, 45 ref.
Swedish Natural Science Research Council Grant B-Bu 3038-112.

Descriptors: *Analytical methods, *Thymidine, *DNA, *Hypereutrophic lakes, *Limnology, *Sediments, *Microbial respiration, Sweden, Lakes, Bacteria, Productivity, Biomass.

(3H)thymidine incorporation into DNA as a measure of heterotrophic bacterial production was determined in the surface (0-2 cm) sediment of hypereutrophic Lake Vallentunasjon, Sweden. Bacterial abundance was 3-15 x ten to the 10th power cells/g of dry sediment. In this lake, about 80% of the microbial biomass in the sediment is cyanobacterial (mainly large Microcystis spp.). During summer, the abundance of bacterial-sized Microcystis incerta was 3 x ten to the 9th power cells/g, roughly 10% of the bacterial abundance as determined by acridine orange direct counts. Bacterial generation times at 20 C were about 2-4 d, increasing to 150 d at 4 C. Bacterial production at 20 C was 12-28 microgram(ug)/g/h, whereas microbial respiration (electron transport system assay and Cartesian diver microrespirometry) was in the range of 60-100 ug/g/h. Considering that part of the microbial respiration was due to cyanobacteria, we feel that the (3H)thymidine method provided realistic estimates of bacterial production. (Author's abstract)
W87-08936

COMPARATIVE EFFECTS OF MINE WASTES ON THE BENTHOS OF AN ACID AND AN ALKALINE POND,
Quebec Univ., Montreal. Dept. des Sciences Biologiques.
For primary bibliographic entry see Field 5C.
W87-08962

EFFECT OF 'WHITING' ON OPTICAL PROPERTIES AND TURBIDITY IN OWASCO LAKE, NEW YORK,
Upstate Freshwater Inst., Syracuse, NY.
S. W. Effler, M. G. Perkins, H. Greer, and D. L. Johnson.
Water Resources Bulletin WARBAQ, Vol. 23, No. 2, p 189-196, April 1987. 6 fig, 2 tab, 27 ref.

Descriptors: *Whiting, *Optical properties, *Turbidity, *Owasco Lake, *Limnology, Epilimnion, Acidification, Light quality, Eutrophication.

The effects 'whiting' (CaCO3 precipitate) had on the optical properties and turbidity of the epilimnion of Owasco Lake, New York, were studied durin the summer of 1985. Turbidity was partitioned according to 'whiting' and non-'whiting' components utilizing a simple acidification procedure. Diffuse light attenuation was partitioned according to the attenuating processes of absorption and scattering. 'Whiting' was present most of the summer. Two major 'whiting' events occurred that caused major increases in turbidity and the attenuation of light. 'Whiting' was the principle regulator of turbidity during the study; it caused increases in light attenuation by increasing light scattering. 'Whiting' events can easily be mistaken by the public for phytoplankton blooms. (Author's abstract)
W87-08966

SEDIMENTATION IN LAKE ONALASKA, NAVIGATION POOL 7, UPPER MISSISSIPPI RIVER, SINCE IMPOUNDMENT,

U.S. Fish and Wildlife Service, La Crosse, WI. Northern Prairie Wildlife Research Center.
For primary bibliographic entry see Field 2J.
W87-08969

LAKE LOADING RATIOS (N:P) AND LACUSTRINE NITROGEN FIXATION,
Oklahoma State Univ., Stillwater. Dept. of Zoology.
D. Toetz, and M. McFarland.
Water Resources Bulletin WARBAQ, Vol. 23, No. 2, p 239-242, April 1987. 1 fig, 2 tab, 29 ref. NSF DEB-80-12095; Oklahoma Water Resources Research Inst. A-106-Okla.

Descriptors: *Lakes, *Limnology, *Nutrient budget, *Nitrogen fixation, *Phosphorus, Cyanophyta, Algae, Nutrients, Nitrogen.

Data from seven diverse lakes with reasonably complete nutrient budgets and estimates of annual areal nitrogen fixation (AANF) were used to evaluate the proposition that nitrogen fixation (NF) declines as the ratio TN:TP in lake loadings increases. The results do not support the conclusion that the rate of AANF in lakes is related to the N:P ratio in extremely generated influents, although low N:P nutrient loading ratios often favor blue-green algae capable of NF. (Author's abstract)
W87-08972

SPATIAL VARIABILITY IN SELECTED PHYSICAL CHARACTERISTICS AND PROCESSES IN CROSS LAKE, NEW YORK,
Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler, and C. F. Carter.
Water Resources Bulletin WARBAQ, Vol. 23, No. 2, p 243-249, April 1987. 6 fig, 2 tab, 23 ref.

Descriptors: *Physical properties, *Cross Lake, *Limnology, *Spatial variation, Seneca River, Stratification, Transparency, Sedimentation, Inflow, Rivers.

Short-circuiting of the inflow occurs from the Seneca River across the southern portion of Cross Lake, New York. Spatial differences in thermal stratification, transparency and light attenuation, and net sedimentation are documented for the lake. The depth of the epilimnion was generally deeper, and the temperature gradient in the metalimnion was at times lower, at a deep-water location proximate to the short-circuiting zone, than at a position more remote from the inflow. Transparency was generally lower, and light attenuation greater, proximate to the short-circuiting zone, indicating the contribution of attenuating components from the river. The net sedimentation rate in the short-circuiting zone was greater and temporally more irregular than for a deep-water position remote from the river inflow. The spatial differences in the physical characteristics and processes in Cross Lake are attributable to the magnitude and position of the inflow from the Seneca River. (Author's abstract)
W87-08973

THERMAL AND DISSOLVED OXYGEN CHARACTERISTICS OF A SOUTH CAROLINA COOLING RESERVOIR,
NUS Corp., Aiken, SC.
J. L. Oliver, and P. L. Hudson.
Water Resources Bulletin WARBAQ, Vol. 23, No. 2, p 257-269, April 1987. 12 fig, 4 tab, 32 ref.

Descriptors: *Limnology, *Keowee Reservoir, *Cooling reservoirs, *Dissolved oxygen, *Temperature, *Nuclear power plants, Thermoclines, Seasonal variation.

Temperature and dissolved oxygen concentrations were measured monthly from January 1971 to December 1982 at 1-m depth intervals at 13 stations in Keowee Reservoir in order to characterize spatial and temporal changes associated with operation of the Oconee Nuclear Station. The reservoir water column was 1 to 4 C warmer in operational than in non-operational years. The thermocline was at depths of 5 to 15 m before the operation of Oconee Nuclear Station, but was always below the upper level of the intake (20 m) after the station was in full operation; this suggests that pumping by the Oconee Nuclear Station had depleted all available cool hypolimnetic water to this depth. As a result summer water temperatures at depths greater than 10 m were usually 10 C higher after plant operation began than before. By fall the reservoir was nearly homothermous to a depth of 27 m, where a thermocline developed. Seasonal temperature profiles varied with distance from the plant; a cool water plume was evident in spring and a warm water plume was present in the summer, fall, and winter. A cold water plume also developed in the northern section of the reservoir due to the operation of Jocassee Pumped Storage Station. Increases in the mean water temperature of the reservoir during operational periods were correlated with the generating output of the power plant. The annual heat load to the reservoir increased by one-third after plant operations began. The alteration of the thermal stratification of the receiving water during the summer also caused the dissolved oxygen to mix to greater depths. (Author's abstract)
W87-08975

DOWNWARD MOVEMENT OF PARTLY DEGRADED MATERIALS IN DYKED MARSH SOILS,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Centre.
H. Dinel, S. P. Mathur, and M. P. Levesque.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 384-389, March-April 1987. 5 fig, 4 tab, 22 ref.

Descriptors: *Diked marshes, *Decomposing organic matter, *Cultivation effects, *Drainage effects, *Limnology, *Sedimentation, *Biochemical oxidation, Biodegradation, Tillage effects, Agriculture, Ontario.

Comparisons were made between organic depth layers of a virgin area (site A) and two fields, cultivated for 6 and 30 yr (sites B and C), all on the Keswick Marsh in the active delta of the Holland (Schomberg) River and Simcoe Lake, Ontario, Canada. Contrary to current concepts and earlier observations for other peat landforms, physical changes in the marsh soils extended beyond the initial period of cultivation while biochemical oxidation appeared to pervade the subsurface layers. Also, an increase in the extent of oxidation with the period of cultivation was clearly evident in the subsurface layers at sites B and C, but not so much in the more aerated and tilled surface layers. These anomalies could be explained if the products of biochemical oxidation were assumed to have moved downwards from the surface zone in these organic soils. This is feasible because these soils are drained rapidly by energetic pumping rather than by gravity alone. This conclusion was supported by variation of particle-size distribution with depth, increase of pollen concentrations in the subsurface, and inversion of 14C dates in certain depth layers of the cultivated fields. The data indicate that measures for controlling the long-term subsidence of cultivated Histosols should be aimed at the surface layer as that is where most of the biochemical oxidation occurs. (Author's abstract)
W87-08998

CAROLINA BAYS ON THE EASTERN SHORE OF MARYLAND: I. SOIL CHARACTERIZATION AND CLASSIFICATION,
Maryland Univ., College Park. Dept. of Agronomy.
M. H. Stolt, and M. C. Rabenhorst.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 394-398, March-April 1987. 3 fig, 3 tab, 19 ref.

Descriptors: *Soil genesis, *Carolina Bays, *Soil classification, *Soil texture, *Basins, Surveys, Sand, Water table fluctuations, Mineralogy.

Fifty-three Carolina bays were examined in a reconnaissance survey to determine general characteristics. Two types of bays were identified based on the texture of the parent materials in the basins. Soils within the basin of 29 of the bays examined had developed in fine textured parent material termed basin fill. The basins of the other 24 bays contained primarily sandy materials. Soils with histic epipedons or Histosols occurred in 20% of the uncultivated bays. Five representative bays were chosen for detailed study. Water table fluctuations were monitored in three wooded study sites. Transects were made along radial axes in five sites. Physical, chemical, and mineralogical properties were examined. The accumulation and translocation of organic matter, movement and illuvitaion of clay, and mineral weathering were the major pedogenic processes occurring in these soils. The amount of organic C in the basin soils was dependent upon the type of vegetation and nature of the parent material. Argillans were found in gleyed Bt horizons even though thick umbric epipedons indicated very poorly drained conditions. The mineralogy of the fine textured soils in the basins was primarily kaolinite, mica, and 2:1 expansible minerals. Soils developed in the basin fill were Histic, Cumulic, or Fluvaquentic Humaquepts, Terric Medisaprists, Typic Umbraqualfs, or Umbraquults. Soils developed in the sandy textured basins were Typic or Histic Humaquepts. Soils on the rims were Typic or Aquic Hapludults. (Author's abstract)
W87-08999

MULTIATTRIBUTE ANALYSIS OF THE IMPACT ON SOCIETY OF PHOSPHORUS ABATEMENT MEASURES,
Center for Industrial Research, Oslo (Norway).
For primary bibliographic entry see Field 5G.
W87-09013

HABITAT MODIFICATION AND FRESHWATER FISHERIES.
For primary bibliographic entry see Field 4C.
W87-09036

REGULATION OF RIVERINE FISH COMMUNITIES BY A CONTINUUM OF ABIOTIC-BIOTIC FACTORS,
Lodz Univ. (Poland). Inst. of Environmental Biology.
M. Zalewski, and R. J. Naiman.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 3-9, 3 fig, 13 ref.

Descriptors: *Limnology, *Model studies, *Fish populations, *Rivers, *Biological properties, Streams, Stream fisheries, Water temperature, Fish physiology.

By comparing riverine fish communities occurring in major geographical areas of the world, it is evident that their structure and dynamics are regulated by a continuum of abiotic and biotic factors. It is demonstrated that abiotic factors are of primary importance in may situations, but where the environment becomes stable or predictable, the role of biotic factors gradually increases in importance. Abiotic factors such as fluvial geomorphology, geology, and climate, and biotic factors such as competition, predation, and productivity influence fish diversity, reproductive strategies, pertinent physiological adaptations and behavior. It is concluded that these abiotic-biotic factors regulate, to a large extent, a continuum of fish communities in rivers. This fish community continuum responds mainly to: (1) Stream order, which expresses a degree of environmental diversity and a degree of stabilization; (2) The temperature regime, which strongly influences the physiological performance of this fish and ecosystem productivity; and (3) The slope of the river, which appears to modify greatly the previous two considerations. In order to explore the concept further, a three dimensional graphical model describing the abiotic-biotic continuum is introduced. (See also W87-09036) (Author's abstract)
W87-09037

EFFECTS ON FISHERIES OF NON-BIOTIC MODIFICATIONS OF THE ENVIRONMENT IN THE EAST-DANUBE RIVER AREA,
Galati Univ., 6200 Galati, Romania.
For primary bibliographic entry see Field 6G.
W87-09038

FALL OF MIGRATORY FISH POPULATIONS AND CHANGES IN COMMERCIAL FISHERIES IN IMPOUNDED RIVERS IN POLAND,
Inland Fisheries Inst., Zabiniec, 05-500 Piaseczno, Poland.
For primary bibliographic entry see Field 6G.
W87-09039

EFFECTS OF IMPOUNDMENT AND REGULATION OF THE RIVER TEES AT COW GREEN (NORTHERN PENNINES, UK) UPON FISH POPULATIONS IN AFFERENT TRIBUTARIES AND IN THE RIVER IMMEDIATELY DOWNSTREAM OF THE DAM,
Freshwater Biological Assoc., c/o Northumberland Water Authority, Lartington Treatment Plant, Barnard Castle, County Durham, DL129DW, UK.
For primary bibliographic entry see Field 6G.
W87-09040

REPURCUSSION OF SMALL HYDROELECTRIC POWER STATIONS ON POPULATIONS OF BROWN TROUT (SALMO TRUTTA) IN RIVERS IN THE FRENCH MASSIF-CENTRAL,
Conseil Superieur de la Peche, Delegation Regionale Auvergne-Limousin, 84 Avenue du Puy-de-Dome, 6300 Clermont-Ferrand, France.
For primary bibliographic entry see Field 6G.
W87-09041

REVIEW OF EFFECTS OF ENVIRONMENTAL DEGRADATION ON THE FRESHWATER STAGES OF ANADROMOUS FISH,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
W. J. Ebel.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 62-79, 6 fig, 54 ref.

Descriptors: *Environmental effects, *Anadromous fish, *Fish populations, *Columbia River, Salmon, Fish passages, Flow velocity, Fish barriers, Fish migration, Reservoirs, Water temperature.

EArly research efforts begun in the 1950s and continued to the present to address the problems of environmental degradation on anadromous fish were centered mainly on fish behavioral work designed to provide solutions to fish passage problems. Information leading to solutions to passage problems for both adult and juvenile salmonids caused by dams and impoundments in the Columbia River was the highest priority of this research. Research on various fisheries enhancement measures was also begun in the late 1960s to increase production of Columbia River salmon. Some conclusions drawn from the study are: (1) Velocities in adult fish passage facilities should fall within the range of 2.4-4.0 m/s for optimum passage of salmonids; (2) Use of electrical guidance systems to divert fish from turbines or into bypass flumes or traps in rivers was effective under controlled conditions, but was impractical for operational field applications; (3) Use of water and air jets, sound, and lights to guide juvenile migrants were effective only under limited and controlled environmental conditions; (4) Travelling screens, suspended at an angle to the stream flow, were effective in flumes or irrigation canals for guiding juvenile migrants, but costs and engineering problems preclude their use at dams or large streams; (5) Adult passage of anadromous salmonids through both large and small reservoirs was not a serious problem in reservoirs studied on the Columbia River, except during periods of high water temperature; (6) Juvenile migrants were adversely affected by the impoundments on the Columbia River, which caused substantial delays in migration. These delays, coupled with changed environmental conditions in the river, caused substantial mortality to juvenile migrants which was as high as 95% in the Columbia River during low flow periods; and (7) Studies of the effect of water temperatures and supersaturation of atmospheric gas on salmonids led to the establishment of water temperature and atmospheric gas standards for the Columbia River. Any increase in temperature above 17-20 C or increase in atmospheric gas above 110% of the air-saturation value was considered detrimental to fish in the Columbia River. (See also W87-09036) (Lantz-PTT)
W87-09042

RESTORATION OF THE RIVER VAIKKO-JOKI, FINLAND,
Kuopio Univ. (Finland). Dept. of Applied Zoology.
T. K. Eronen, and P. Shemeikka.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 109-115, 4 fig, 1 tab, 1 ref.

Descriptors: *Vaikkojoki River, *Finland, *Rivers, *Water quality control, Fish populations, Recreation, Trout, Fish stocking, Littoral zone, Spawning.

The Vaikko River is about 50 km long, approximately 6 km of which consist of rapids in which there are 60 m of waterfalls. The mean discharge is about 5 cu m/s, but fluctuates widely because few lakes occur in the course of the river. The river was cleared for timber-floating at the beginning of the 1960s by moving the stones from the rapids with bulldozers and making them into walls on the riverbanks. The restoration of the Vaikko River was based on the natural capacity of the river, but different uses had to be taken into consideration, and therefore it was not possible to obtain an ideal solution, e.g. for salmonid fish. A compromise was made between the improvements required for fish habitats and those for boating. The rapids were refilled with stones, yet always leaving a free passage for boats and canoes; gravel areas for spawning-beds were prepared in the headwaters, and the littoral zone was laid with small stones to provide rearing areas for young trout, large stones being placed to the side of the navigation channel. Two-year old and younger brown trout were stocked into the river immediately after restoration. Several matters appear to need improvement in restoration work. No detailed plan was possible because of the length of the river, and therefore the desired results were often not reached immediately, requiring the work to be re-done. The main problem was to create enough water surface in the rapids and to maintain adequate shelter for larger fish during minimum flow. Also, boating seems to disturb fish more than expected. Although restored, the river will require continuous care in order to maintain the benefits of restoration. (See also W87-09036) (Author's abstract)
W87-09046

REVIEW OF BROWN TROUT (SALMO TRUTTA) SPAWNING BEDS, INDICATING METHODS FOR THEIR RE-ESTABLISHMENT IN DANISH LOWLAND RIVERS,
Skanderborg Town Council, The Fishery Project, Adelgade 44, DK-8660 Skanderborg (Denmark).
H. Hermansen, and C. Krog.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 116-123, 4 fig, 10 ref.

Descriptors: *Trout, *Spawning, *Denmark, *Rivers, Gravel beds, Flow profile, Water level, Sediment load, Oxygenation, Canals, Fisheries.

The permeable gravel areas on which trout spawn are part of the dynamic equilibrium of the stream and therefore depend on the flow regime of the stream and the morphology and use of the entire catchment area. Discharge, morphology and composition of the gravel bed are considered to be the most important factors influencing spawning bed quality, and determine the means of rehabilitating spawning beds in Danish lowland rivers. These are: (1) reduction of wide fluctuations in discharge, and lowering of the discharge itself; (2) reduction of sediment load by reducing in-stream erosion and supply of solids derived from surface runoff; (3) creation of gravel bed morphology so as to facilitate the interchange of oxygenated water from the stream with the interior of the bed. The results of previous attempts to reestablish destroyed spawning beds in canalized rivers in Denmark have indicated that: (1) stream deflectors do not function in lowland rivers with a slope less than 1/4000; (2) stream deflectors do not function in lowland rivers with a large sediment load; and (3) fertile trout can be attracted by conditions to artificial spawning grounds. In future, the situation of the entire catchment area must be considered, because it controls many of the factors influencing the conditions at spawning beds. Specifically the possible use of existing weirs must be investigated to create a large fall, without interfering with agricultural interests. (See also W87-09036) (Author's abstract)
W87-09047

PHYSICAL AND BIOLOGICAL EFFECTS OF GRAVEL EXTRACTION IN RIVER BEDS,
CEMAGREF - Groupement d'Aix-en-Provence, Section Qualite des Eaux, BP99-13603, Aix-en-Provence, France.
For primary bibliographic entry see Field 4C.
W87-09049

EFFECT OF HABITAT MODIFICATION ON FRESHWATER FISHERIES IN LOWLAND AREAS OF EASTERN ENGLAND,
Anglian Water Authority, Ambury Road, Huntingdon, Cambridgeshire PE186NZ, UK.
R. S. J. Linfield.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 147-156, 3 fig, 1 tab, 20 ref.

Descriptors: *Habitat modification, *Fisheries, *England, Case studies, Drainage, Fish populations, Biomass, Surveys.

A large proportion of the major freshwater fisheries in the low lying areas of eastern England owe their existence to schemes for land drainage and navigation during past centuries. In more recent times, however, further habitat modifications (excepting creation of new reservoirs) have been viewed by many as prejudicial to fish populations and an apparent decline in the standard of many fisheries since the 1960s is popularly attributed to this cause by conservationists and anglers. Briefly reviewed here is the nature of the habitat changes brought about in recent years in East Anglian rivers and the measures taken by the Anglian Water Authority to assess their implications to freshwater fish populations in affected watercourses. Case histories supported by quantitative fish population data are given in respect of the Norfolk Broads, the Ely-Ouse to Essex Water Transfer Scheme, the Trent-Witham-Ancholme Water Transfer Scheme, and the Southern Lincolnshire limestone water resources scheme. In spite of immense variation in observed fish biomass data arising from combinations of variables, an inverse relationship between fish stock levels and intensity of navigation is illustrated using data from 880 sites surveyed in the years 1978-1982. Remedial measures to compensate for reduced fish production arising from habitat limitations are outlined and discussed. (See also W87-09036) (Author's abstract)
W87-09050

EFFECTS ON SALMONID POPULATIONS OF ISOLATION OF A LAKE FROM A RIVER SYSTEM,
Central Electricity Generating Board, Llandegai Industrial Estate, Bangor, Gwynedd LL574YH, UK. Biology Lab.
For primary bibliographic entry see Field 6G.

W87-09051

WHITEFISH AND VENDACE STOCKS IN THE REGULATED LAKE PYHAJARVI, CENTRAL FINLAND,
Jyvaskyla, SF-40100 Jyvaskyla 10 (Finland). Environment Research Centre.
A. Huhmarniemi, A. Niemi, and R. Palomaki.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 165-172, 3 fig, 2 tab, 9 ref.

Descriptors: *Fish management, *Lake Pyhajarvi, *Finland, *Whitefish, Water level, Fish populations, Fish stocking, Fisheries, Spawning.

The oligotrophic Lake Pyhajarvi has been regulated since 1961. The area of the lake is 115 sq km, and the total amplitude of the regulated water level 1.26 m. Up to 1974, the whitefish stock consisted mainly of slow-growing, lake spawning fish, with a gillraker count of 44 + or - 5. Before regulation, the catch of this stock (called Pyhajarvi lake whitefish) was about 8 tons. In 1971, the catch had fallen to 4 tons, although the fishing effort had more than doubled. Since 1974, Lake Pyhajarvi has been stocked with 1-summer-old fingerlings of plankton whitefish (coregonus muksun) and peled whitefish (C. peled). The average yield is 78 kg/1000 stocked fingerlings. As a result of stocking, the total whitefish catch is now about 16 tons, or four times the catch before stocking. The stock of vendace has diminished during regulation, catches falling from 60 tons in the early 1970s to 10 tons in 1982. The Pyhajarvi lake whitefish spawn at a depth of 0.5-2 m, with maximum egg density at 1 m. Approximately 80% of the eggs are destroyed by the winter drawdown. Increased egg mortality due to regulation is suggested as the cause of the lake whitefish decline. The spawning depth of vendace is 206 m, and it is probable that regulation does not directly affect the reproduction of this species. Regulation has, however, increased the nutrient and humus load in the northern parts of the lake, and thus may have indirectly weakened the reproductive success of vendace. (See also W87-09036) (Author's abstract)
W87-09052

WATER LEVEL REGULATION OF LAKE INARI: IMPACTS AND COMPENSATION MEASURES,
National Board of Waters, Helsinki (Finland).
K. Kaatra, and O. Simola.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 173-178, 1 tab, 11 ref.

Descriptors: *Water level, *Lake Inari, *Finland, Fish populations, Char, Fish management, Salmon, Fish stocking, Ecological effects.

The ecological impact and compensation stocking, connected with the artificial water level fluctuations of Lake Inari (northern Finland) are reviewed. Stocking with Arctic char (Salvelinus alpinus) and lake char (Salvelinus namaycush) has been fairly successful, giving average yields per 1000 tagged juveniles of 118 and 127 kg, respectively. Preliminary tagging results of stocking with brown trout (Salmo trutta) and land-locked salmon (Salmo salari) have been rather poor, perhaps because the newly stocked smolts migrate out of the lake. Better results may be sought by improving methods of breeding, increasing the size of the smolts, delaying the spring stocking and seeking better locations for releasing the fish. (See also W87-09036) (Author's abstract)
W87-09053

DEVELOPMENT OF FISH STOCK AND FISH POPULATIONS IN LAKE INARI,
Finnish Game and Fisheries Research Inst., Inari (Finland). Fisheries Div.
A. Mutenia.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 179-185, 1 fig, 1 tab, 8 ref.

Descriptors: *Lake Inari, *Fish populations, *Finland, *Environmental effects, *Water resources development, Erosion, Water management, Trout, Salmon, Smolts, Char, Water level.

Lake Inari is located at the junction of the subarctic and temperate zones (69deg N, deg 28deg E). Its area is 1153 sq km and it has survived to the present day ats a clean oligotrophic lake. Water control measures for power production, starting with the establishment of a power station on the river Paatsjoki, in Soviet territory, in 1948, have tended to alter its natural state. The maximum storage amplitude is 2.36 m. Control measures lead to strong erosion, which in turn has caused a reduction in the littoral flora and benthic fauna. The result has been a decline in fish reproduction and a reduction in available nutrients. Fishing during the period in which control has been exerted has declined. At the commencement of control there were 140 professional fishermen on the lake but toward the end of the 1970s only half of them were still operating. The number of subsistence and recreational fishermen more than trebled between the end of the 1960s and the close of the 1970s. L. Inari is presently one of the most popular tourist fishing grounds in northern Finland. Prior to control, the catch was 250 tons/yr (2.5 kg/ha). With the commencement of control, annual catches began to decline; these were 78 tons in 1966-1970 and 85 tons in 1981 (0.8 kg/ha). It is estimated that 80% of the decrease in catch is attributable to water level regulation, and 20% to other factors. In order to compensate for water control on L. Inari, it has been decreed that 1 million one-summer-old whitefish fingerlings, 100,000 migratory-sized brown trout or land-locked salmon smolts, and 250,000 one-summer char or lake trout shall be stocked annually. (See also W87-09036) (Author's abstract)
W87-09054

FOOD OF WHITEFISH (COREGONUS LAVARETUS) IN TWO NEIGHBOURING LAKES, ONE REGULATED AND THE OTHER NATURAL,
Finnish Game and Fisheries Research Inst., Helsinki (Finland).
O. Heikinheimo-Schmid.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 186-194, 3 fig, 1 tab, 21 ref.

Descriptors: *Whitefish, *Water resources development, *Lakes, *Oulujoki River, *Finland, *Ecological effects, Fish populations, Water level, Powerplants, Zooplankton, Mollusks, Fish food organisms, Fish food.

The diet of whitefish was studied in two lakes drained by the Oulujoki River, northern Finland. L. Anattaijarvi is in its natural state, and the mean number of gillrakers of whitefish was 45. The water level of L. Kiantajarvi is regulated for hydroelectric power, and two types of whitefish were found, with an average of 30 and 42 gillrakers, respectively. In L. Anattijarvi, the most important food organisms were fish eggs in spring, bottom animals (especially Mollusca, Ephemeropter nymphs and Trichoptera larvae) in summer and late autumn, and zooplankton in early autumn. In the regulated L. Kiantajarvi, zooplankton made up the bulk of the stomach contents of both whitefish groups during the summer. Bottom animals, mostly chironomid larvae, were scarce in the diet in summer, but increased toward the autumn. Mollusca and large insect larvae and nymphs were almost entirely lacking. Terrestrial or emerging insects were important food organisms in June and September. The diets of the two types of whitefish partly overlapped, but those with 24-34 gillrakers utilized more bottom food than those with 35-49 gillrakers, and also preferred different zooplankton species. It was concluded that bottom animals important as fish food (Mollusca, large insect larvae and nymphs) had declined in the regulated L. Kiantajarvi, which had led to more severe food competition between the two whitefish populations. (See also W87-09036) (Author's abstract)
W87-09055

FISH STOCKS AND FISHING IN THE LOKKA AND PORTTIPAHTA RESERVOIRS, NORTHERN FINLAND,
Finnish Game and Fisheries Research Inst., Inari (Finland). Fisheries Div.
A. Mutenia.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 195-201, 2 fig, 3 tab, 6 ref.

Descriptors: *Fish stocking, *Fish populations, *Lokka Reservoir, *Porttipahta Reservoir, *Finland, Fishing, Water level, Ecological effects, Pike, Perch, Whitefish.

The Lokka and Porttipahta reservoirs (Lapland, 68 N, 27 E) built during the late 1960s for water power and flood control purposes are among the largest in Europe, the maximum surface area being 417 sq km and 214 sq km, respectively. The amplitude of water level fluctuations is 5 m and 11 m respectively. The reservoirs were constructed on a bog and forest area, having only 2-4% as rivers and lakes. Fish present consisted mostly of river species and, following construction of the reservoirs, strong year-classes of roach, burbot and perch were produced. Reservoirs have habitually produced annual increments in catches as a result of strengthening fish stocks and intensified fishing. The annual catch of the Lokka reservoir in the years 1975-1980 was, on average, 102.6 tons, the catch per hectare being 3.5 kg/ha per year. Corresponding figures for the Porttipahta reservoir are 93.3 tons and 8.3 kg/ha per year. The pike has been the most important species and good pike and perch stocks, together with successful stocking of Siberian peled whitefish (Coregonus peled), have led to increased commercial and some significant recreational fishing. There are 30 commercial fishermen on the reservoirs; half of the households in the district engage in subsistence fishing, while in some years more than 5000 licenses for the reservoirs have been issued to visiting fishermen. The amount of reservoir fish purchased commercially was 83 tons in 1977, 90 tons in 1980 and 166 tons in 1982. The total catch from the two reservoirs in 1982 was 270 tons. (See also W87-09036) (Author's abstract)
W87-09056

INTRODUCTION OF MYSIS RELICTA IN SWEDEN: EFFECTS ON FISH IN IMPOUNDED LAKES,
Institute of Freshwater Research, Drottningholm (Sweden).
M. Furst, J. Hammar, and C. Hill.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 202-206, 14 ref.

Descriptors: *Ecosystems, *Sweden, *Shrimp, *Fish populations, *Lakes, Water level, Mysis relicta, Zooplankton, Cladocerans, Lake fisheries, Limnology.

The opossum shrimp (Mysis relicta) has been introduced into a large number of impounded Swedish lakes to compensate for the loss of benthic organisms due to water level regulation. This paper summarizes the results of the last 25 years, during which Mysis has become established in 50 of the lakes and spread downstream. The introduction of Mysis has favored benthic fish species but, on the other hand, Mysis competes with populations due to its selective predation on zooplankton. Several species of cladocerans have become less abundant. The pelagic fish do not change over to a diet of Mysis, and their numbers become greatly reduced. Parasitism of fish by the tapeworms Diphyllobothrium spp. and Triaenophorus spp. has decreased in benthic species and increased in pelagic species.

Mysis has become important as a fish-food organism during the winter. There has been a shift in concentration of fish toward deeper water. The observed changes suggest that a small portion of the potential energy in the pelagic zone is available to benthic fish species, but that the decline of the pelagic fish represents a decrease in the total fish production in the lakes. Recommendations for future fisheries management are presented. (See also W87-09036) (Author's abstract)
W87-09057

ASSESSMENT OF THE FLOW REQUIREMENTS FOR UPSTREAM MIGRATION OF SALMONIDS IN SOME RIVERS OF NORTH-WEST ENGLAND,
North West Water Authority, Warrington, Cheshire, UK.
D. Cragg-Hine.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 209-215, 2 fig, 7 ref.

Descriptors: *Flow rates, *Salmon, *England, *Fish migration, Stream fisheries, Simulation analysis, Water level, Seasonal variation.

Automatic fish counters, operating on the resistivity principle, have been used for several years in North-West England to investigate the flow requirements for upstream migration of salmon and migratory trout. The data obtained have confirmed that during the summer months most fish movement occurs in the higher range of the available flows, but the migration flow range varies from year to year, depending on prevailing river levels. Of the other environmental variables measured, only water temperature and incident light intensity appear to have any direct association with fish movement. Information on migration flow ranges has been used in conjunction with computer simulations of the effects of abstraction proposals on historical flows to assess the implications of these proposals for migratory fish. (See also W87-09036) (Author's abstract)
W87-09058

PHYSICAL STRUCTURE AND BROWN TROUT (SALMO TRUTTA FARIO) POPULATIONS IN SMALL DANISH LOWLAND STREAMS,
Ribe County Council, 35 Sorsigvej, DK-6760 Ribe (Denmark). Div. of Environmental Affairs.
C. Krog, and H. Hermansen.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 216-222, 3 fig, 4 ref.

Descriptors: *Denmark, *Trout, *Stream fisheries, *Fish populations, Flow velocity, Water level, Macrophytes, Physical properties, Fishing, Aquatic vegetation.

The physical factors - gradient, mean depth, coefficient of variation in depth, mean current velocity and variation in current velocity 7 cm above the bed, ratio of wetted perimeter to width, extension of overhanging banks and degree of macrophyte cover - were surveyed in addition to electric fishing in 20 sections, about 100 m long, in three streams. Some sections were surveyed more than once and altogether 38 surveys were carried out. Most of the physical factors were intercorrelated, especially the coefficients of variation in depth and current velocity and the degree of macrophyte cover. The physical factor best correlated with number of trout greater than 15 cm was the coefficient of variation in current velocity 7 cm above the bed. Poor correlation was found with bank cover, probably because of the high degree of self-shading which was expressed as a high ratio of wetted perimeter to width for many sections. There was no correlation with area and volume of section. Distinct vertical and horizontal windings of the deepest part of the waterway were seen even in the canalized sections. Cessation of weeding in the canalized sections caused a large variation in stream structure within about one year, as shown for example by a higher coefficient of variation in current velocity and a more winding vertical stream course. This illustrates the natural ability of streams for recovery which can be utilized in the improvement of inland fisheries. (See also W87-090036) (Author's abstract)
W87-09059

EFFECT OF RECREATIONAL USES UPON AQUATIC ECOSYSTEMS AND FISH RESOURCES,
Inland Fisheries Inst., Bloc 5, 10-957, Olstyn-Kortowo (Poland).
For primary bibliographic entry see Field 6G.
W87-09060

EFFECTS OF HABITAT MODIFICATION ON FRESHWATER CRAYFISH,
Finnish Game and Fisheries Research Inst., Helsinki (Finland).
For primary bibliographic entry see Field 4C.
W87-09062

ECOLOGY OF ESTUARIES, VOLUME I: PHYSICAL AND CHEMICAL ASPECTS,
GPU Nuclear Corp., Forked River, NJ. Environmental Controls Dept.
M. J. Kennish.
CRC Press, Inc., Boca Raton, FL. 1986. 254 p.

Descriptors: *Estuaries, *Ecology, *Physical analysis, *Chemical analysis, Ecosystems, Water quality, Coastal waters, Social impact.

The rapid development of estuarine ecology as a field of scientific inquiry reflects a growing awareness of the immense societal importance of these coastal ecosystems. The many, varied, and increasingly complex problems arising from anthropogenic use of estuaries have focused attention on the pressing need to protect estuarine resources and to assess each system's physical, chemical, and biological conditions. As a result of the heightened public concern related to the water quality of coastal regions in the United States, for example, numerous detailed and quantitative research programs were undertaken in the 1960s, 1970s, and 1980s, which provided a basic understanding of the process operating in many estuaries. The information derived from these programs has also aided decision making bodies at all levels - that plan for the utilization of natural resources - to make sound decisions dealing with these dynamic waters. The objective of this book is to review the physical and chemical characteristics of estuaries. The volume has been designed principally as a reference for scientists, but administrators, managers, decision makers, and other professionals involved in some way with estuarine research can find value in the text. In addition, attempts have been made to integrate the diverse components of estuarine ecology, to assemble citations of the major articles and books investigating physical and chemical processes in estuaries, and to present the subject matter in an organized framework which should assist undergraduate and graduate students pursuing courses in this field. (Lantz-PTT)
W87-09066

HUMIC SUBSTANCES IN SOIL, SEDIMENT, AND WATER: GEOCHEMISTRY, ISOLATION, AND CHARACTERIZATION.
Geological Survey, Denver, CO. Water Resources Div.
John Wiley and Sons, New York, NY. 1985. 692 p. Edited by George R. Aiken, Diane M. McKnight, Robert L. Wershaw and Patrick MacCarthy.

Descriptors: *Humic substances, *Soil, *Sediments, *Geochemistry, *Path of pollutants, Metals, Chemical reactions, Chemical properties.

Presented is an organized, comprehensive treatment of the geochemistry, isolation and characterization of humic substances. The authors differentiate between what is known, what is conjecture, and what is not known about humic substances. In the first section of this book, the path of these substances is logically followed between geochemical environments, including the interactions of humic substances with metals and organic pollutants within each environment. The second and third sections of this book present critical evaluations of methods for isolating and characterizing humic substances from solid phases (soils, sediments, and peats) and from the aquatic environment. Each chapter reviews the fundamental aspects of the methodology and discusses its application to understanding the nature and geochemical reactivity of humic substances. (See W87-09067 through W87-09082) (Lantz-PTT)
W87-09067

GEOCHEMISTRY OF HUMIC SUBSTANCES IN NATURAL AND CULTIVATED PEATLANDS,
Department of Agriculture, Ottawa (Ontario). Soil Research Inst.
S. P. Mathur, and R. S. Farnham.
IN: Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization. John Wiley and Sons, New York, NY. 1985. p 53-85, 2 fig, 14 tab.

Descriptors: *Wetlands, *Peat bogs, *Humic substances, *Geochemistry, *Humification, Organic compounds, Soil chemistry, Humic acids, Pyrophosphates, Hydrogen ion concentration, Chemical analysis, Decomposition, Enzymes.

Peatlands, or organic soils, are water-logged deposits of partly decomposed plant debris. Ecological variation and diversity in extent of domination by water influence the degree of humification in peatlands. Humification in peatlands does not coincide with decomposition as well as in mineral soils. Measurement and extraction of peatland humus are hampered by the presence of large proportions of unhumified material. Therefore, most studies on the characterization of peatland humus have focused on humic acids, or on pyrophosphate extracts of the organic soils. Pyrophosphate extracts contain less unhumified materials than alkali extracts but are far less effective in extracting the peat humic substances. Elemental composition, functional group analyses, spectral properties, and characterization of acid hydrolysates have shown that peat humic acids tend to be similar to those from mineral soils. NMR spectroscopy has revealed that peat fulvic acids are largely carbohydrate in nature while the residue of alkali extraction is not all humin. Drainage, liming, fertilization, and cultivation of peatlands all enhance decomposition and humification. Since humus is more compact than plant debris, cultivated organic soils subside (lose surface elevation typically by about 2.5 cm/yr). Humification and subsidence threaten to destroy valuable cultivated soils. A new method is now being used to retard the subsidence of cultivated peatlands by about a factor of 2. It is based on recent observations: (1) that the rate of decomposition and humification of cultivated organic soils is determined by activities of soil enzymes; and (2) that of all the feed and fertilizer elements, copper is most effective in inactivating the soil enzymes. The recommended rates of copper application have been found to be effective, safe, and economic. The addition of copper tends to increase plant-availability of manganese, zinc, and iron, perhaps due to displacement of these metals by copper from sites of strong complexation to weaker ligands. The humus in well-decomposed organic soils also plays a role in the bioavailability and retention of minor elements, pesticides, and pesticide degradation products, but this role is currently not well understood. (See also W87-09067) (Author's abstract)
W87-09069

GEOCHEMISTRY AND ECOLOGICAL ROLE OF HUMIC SUBSTANCES IN LAKEWATER,
Bayer Landsstodt fur Washerwirtschaft, Munchen (Germany, F.R.).
C. Steinberg, and U. Muenster.
IN: Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization. John Wiley and Sons, New York, NY. 1985. p 105-145, 18 fig, 4 tab.

Descriptors: *Geochemistry, *Limnology, *Lakes, *Humic substances, *Ecology, Dissolved solids, Organic carbon, Phenols, Ecological effects, Organic matter, Chemical reactions, Chemical analysis, Biodegradation, Lake morphology.

In lakes, the pool of dissolved organic carbon (DOC) is dominated by dissolved humic substances (up to 80% of the DOC). Lake humic substances are similar to soil humic substances in that carboxyl, hydroxyl, phenol, and probably methoxyl groups are of major significance. Fluorescence spectra of DOC may be interpreted in terms of the different geochemical origins of DOC (e.g., allochthonous versus algal derived). One or more moieties of dissolved humic substances are produced autochthonously; mechanisms may include polymerization of phenols (promoted by transition metals), Maillard condensations, or oxidation via phenolase systems. Aliphatic structural units in dissolved humic substances provide a flexible conformation to the humic substance 'molecule'. Losses of dissolved humic substances from the water column occur via adsorption onto surfaces of minerals and by cleavage upon exposure to UV radiation or ozone. Cleavage of humic 'molecules' seems to be an important step in the decomposition of humic substances by microbes. Easily degradable substrates in the DOC pool (glucose, lactate, etc.) appear to stimulate microbial degradation of humic substances, either by a priming effect of an easily degradable substrate or by bacterial cometabolism. These organic nutrients also enhance uptake of metals from metal-organic complexes. Dissolved humic substances complex or sorb major cations, trace metals, trace anions, and hydrophobic pollutants (e.g., pesticides), and thereby change both bioavailability and geochemical cycling of these substances. Furthermore, humic substances inhibit precipitation of calcium carbonate and can catalyze certain photochemical and redox reactions. Dissolved humic substances can bind microbially significant substrates such as carbohydrates and proteins and it may be that this interaction reduces the concentration of proteins and carbohydrates usable by microorganisms to below threshold levels. Comparison of humic substances from different lakes indicates a high variation in concentration, composition, and molecular weight. The extent to which differences in methodology contribute to this variation has not been evaluated. Temporal and spatial distributions of dissolved humic substances and humic-associated organic substances are presented for five representative lakes. (See also W87-09067) (Author's abstract)
W87-09071

GEOCHEMISTRY OF HUMIC SUBSTANCES IN LAKE SEDIMENTS,
Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.
R. Ishiwatari.
IN: Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization. John Wiley and Sons, New York, NY. 1985. p 147-180, 8 fig, 11 tab.

Descriptors: *Geochemistry, *Lake sediments, *Humic substances, *Limnology, Chemical analysis, Aquatic organisms, Biodegradation, Phytoplankton.

Humic substances are the most abundant organic constituents in lake sediments and play a central role in the geochemical cycle of carbon in lakes, lake sediments, and sedimentary rocks. Humic substances in lakes and lake sediments originate both from aquatic organisms living in the lake (autochthonous) and from organic matter that is washed into the lake from surrounding soils and streams (allochthonous). The chemical characteristics of the lake humic substances indicate that they are mainly autochthonous in normal freshwater lakes. The humic substances in the uppermost layer of a freshwater lake sediment form very rapidly from dead phytoplankton cells. In the deeper layers of the sediment the formation of humic substances continues to take place but at a slower rate. Humic substances undergo diagenetic changes with burial of the sediment. These changes include a gradual decrease with depth of burial of humic and fulvic acids and a concomitant increase of humin. (See also W87-09067) (Author's abstract)
W87-09072

GEOCHEMISTRY OF STREAM FULVIC AND HUMIC SUBSTANCES,
Geological Survey, Denver, CO. Water Resources Div.
R. L. Malcolm.
IN: Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization. John Wiley and Sons, New York, NY. 1985. p 181-209, 5 fig, 2 tab. EPA and USGS Interagency agreement AD-14-F-1-559, NSF Grant CHE-8208821.

Descriptors: *Geochemistry, *Fulvic acids, *Humic acids, *Ogeechee River, *Georgia, Water chemistry, Organic matter, Metals, Biodegradation, Organic compounds, Path of pollutants, Hydrogen ion concentration, Chemical analysis.

A brief history of the study of stream humic substances is divided into four periods: 'Previous to 1950', the 'Awakening Period' (1950-1964), the 'Sephadex Period' (1964-1973), and the 'Resurgence Period' (1973-present). The major researchers, their philosophy and research approaches, and significant research findings for each period are discussed. A state-of-the-art characterization of representative stream fulvic and humic acids from the Ogeechee River in Georgia is presented. A critical review of the geochemistry of stream humic substances relative to occurrence, origin, theories of formation, structure, acid properties, metal associations, organic solute associations, and biological aspects is summarized. The study of humic substances in water has been strongly influenced by soil science in the past, but the individuality of the science of stream humic substances is emerging. The new science is founded on recent breakthroughs in stream humic chemistry which have resulted from a large influx of interdisciplinary talented researchers, innovative experimental designs, and the application of advanced theories and mathematical modeling. The science of stream humic substances is advancing and changing so rapidly that approaches and theories of only a decade ago are now outdated. (See also W87-09067) (Author's abstract)
W87-09073

GEOCHEMISTRY OF HUMIC SUBSTANCES IN ESTUARINE ENVIRONMENTS,
Maine Univ., Walpole. Ira C. Darling Center for Research, Teaching and Service.
L. M. Mayer.
IN: Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization. John Wiley and Sons, New York, NY. 1985. p 211-232, 4 fig, 2 tab. NSF Grants OCE 7920244 and ISP 8011448, and NOAA Sea Grant R/LRF-45.

Descriptors: *Geochemistry, *Humic substances, *Estuaries, *Path of pollutants, Chemical analysis, Hydrogen ion concentration, Aggregates, Humic acid, Sediments, Trace metals.

The concentration and nature of humic substances in estuarine water and sediments are similar to humic substances of the terrestrial and marine environments, and often appear to consist of simple mixtures of these two end members. The bulk of aquatic humic substances derives from input by rivers. Mixing of river water with seawater causes several chemical changes in riverine humic substances, including increasing saturation of ion-exchange sites with alkaline earth ions, contraction of the molecules, and aggregation of high-molecular-weight materials, including most of the humic acid fraction. Aggregation may induce retention of some humic substances in estuarine sediments, but affects only a small proportion of total humic substance pool. The bulk of the riverine humic substances passes through the estuary to the sea, undergoing little aggregation or metabolism during passage. Humification processes should be intense in estuaries compared to the open ocean, but have been observed in only a few studies. Humic substance complexation of trace metals should decrease with increasing salinity if riverine humic substances were the only ligands of importance; however, sparse field data suggest that estuarine- or marine-derived ligands are more important than those of riverine origin. It is likely that humic substance complexation of organic pollutants is important in pollutant cycling, but the estuarine chemistry of this interaction has received little study. (See also W87-09067) (Author's abstract)
W87-09074

GEOCHEMISTRY OF HUMIN,
Geological Survey, Reston, VA.
P. G. Hatcher, I. A. Breger, G. E. Maciel, and N. M. Szeverenyi.
IN: Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization. John Wiley and Sons, New York, NY. 1985. p 275-302, 9 fig, 1 tab.

Descriptors: *Geochemistry, *Humin, *Sediments, *Marine environment, *Humic substances, *Humic acids, *Peat bogs, *Soil, Chemical analysis, Nuclear magnetic resonance, Peat, Hydrolysis, Algae, Clays, Polysaccharides, Parrafin.

Humin is the insoluble fraction of sedimentary humic substances. Little is known of its chemical composition and of its individuality as a class of humic substances, primarily because its macromolecular nature and complexity have precluded detailed analyses by conventional methods used for organic structural analyses. The advent of solid-state 13-C NMR has allowed new structural information to be obtained in studies of humin. NMR spectra of humin from three major types of depositional environments, aerobic soils, peats, and marine sediments, show significant variations that delineate structural compositions. In aerobic soils, the spectra of humin show the presence of polysaccharides and aromatic structures most likely derived from the lignin of vascular plants. However, another major component of humin show the presence of polysaccharides and aromatic structures most likely derived from the lignin of vascular plants. However, another major component of humin is one that contains paraffinic carbons and is thought to be derived from algal or microbial sources. Hydrolysis of the humin effectively removes polysaccharides, but the paraffinic structures survive, indicating that they are not proteinaceous in nature. The spectra of humin differ dramatically from that of their respective humic acids, suggesting that humin is not a clay-humic acid complex. In peat, humin is composed of lignin-derived structures, polysaccharides, and a large concentration of paraffinic structures as determined from the NMR spectra. Examination of vertical profiles of peat shows that the polysaccharides are degraded very rapidly with depth, whereas the lignin and paraffinic structures are selectively preserved. Humin from a marine algal deposit, a sapropel, is composed almost entirely of polysaccharides and paraffinic structures. With depth in the sapropel, the polysaccharides are degraded and lost and the paraffinic structures are selectively preserved. These structures are eventually transformed over time to kerogen in oil-producing shales. The paraffinic structures, which undoubtedly originate from algae or other microorganisms in this sapropel, are highly branched and have carboxyl, ether, and amide functional groups associated with them. (See also W87-09067) (Lantz-PTT)
W87-09077

NATURE OF NITROGEN IN HUMIC SUBSTANCES,
Chemical and Biology Research Inst., Research Branch, Agriculture Canada, Ottawa, Ontario.
M. Schnitzer.
IN: Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization. John Wiley and Sons, New York, NY. 1985. p 303-325, 13 fig, 11 tab.

Descriptors: *Nitrogen, *Humic acids, *Humin, Chemical analysis, Nitrogen compounds, Agriculture, Fulvic acids, Ammonia, Amino sugars.

This chapter highlights the current state of knowledge on the distribution of different types of nitrogen compounds in humic substances and to project

future research needs, especially with regard to the identification of the unknown nitrogen in humic substances and the relationship between carbon and nitrogen. Humic acids and humin contain between 2 and 6% nitrogen, whereas the range for fulvic acids varies from <1 to 3%. From the agricultural point of view, nitrogen is a key nutrient element required by most crops in relatively large amounts. It is also the only element not released by the weathering of minerals; its source is the atmosphere where N2 is the predominant constituent. A few microorganisms have the ability to fix molecular N2 and to reduce it to ammonia. In the past, most of the research on nitrogen in humic substances has been concerned with proteinaceous components, amino sugars, and ammonia. This leaves one-third to one-half of the total nitrogen unidentified. (See also W87-09067) (Author's abstract)
W87-09078

ISOLATION AND CONCENTRATION TECHNIQUES FOR AQUATIC HUMIC SUBSTANCES,
Geological Survey, Denver, CO. Water Resources Div.
G. R. Aiken.
IN: Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization. John Wiley and Sons, New York, NY. 1985. p 363-385, 4 fig, 7 tab.

Descriptors: *Chemical analysis, *Humic substances, *Aquatic environment, *Water analysis, Humic acids, Organic compounds, Filtration, Resins.

Research on humic substances in water has been almost exclusively concerned with the dissolved fraction. Suspended organic carbon, very important in so called 'black waters' such as tropical rivers, swamps, and bogs where concentrations of humic substances are high, has been little studied and much research is needed in this area. Dissolved organic carbon can be divided into six fractions: hydrophobic acids, bases, and neutrals; and hydrophilic acids, bases and neutrals. A critical review is presented of the methods commonly used to isolate and concentrate aquatic humic substances. The important steps in any extraction scheme are filtration, concentration, isolation, and preservation. Various filtration options are outlined and compared; filtration is important for obtaining low-ash humic substances. Advantages and disadvantages of commonly used concentration and isolation techniques are discussed, and sorption on the synthetic macroporous resins XAD-8, a nonionic resin, and Duolite A-7, a weak anion-exchange resin, are recommended as the most efficient methods. Two established extraction schemes utilizing these resins are discussed. (See also W87-09067) (Lantz-PTT)
W87-09080

MECHANISMS OF ENRICHMENT AT THE AIR-WATER INTERFACE,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
For primary bibliographic entry see Field 5B.
W87-09169

PRINCIPLES AND PROBLEMS OF MODELING CATION ENRICHMENT AT NATURAL AIR-WATER INTERFACES,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W87-09170

INPUT OF BIOLOGICALLY AVAILABLE PHOSPHORUS BY PRECIPITATION TO PRECAMBRIAN LAKES,
Ontario Ministry of the Environment, Rexdale. Limnology and Taxonomy Section.
For primary bibliographic entry see Field 5B.
W87-09174

IMPORTANCE OF ATMOSPHERIC FLUXES TO THE NITROGEN BALANCE OF LAKES IN THE FLORIDA PENINSULA,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
J. Messer, and P. L. Brezonik.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 217-236, 1 fig, 5 tab, 47 ref.

Descriptors: *Atmospheric fluxes, *Nitrogen, *Florida, *Path of pollutants, *Limnology, *Water pollution effects, *Lake Okeechobee, Lakes, Nitrites, Precipitation, Pollutant load, Hydrogen ion concentration, Chemical analysis.

The nitrogen cycle in Florida is dominated by the anthropogenic input to the troposphere of NO2 and NH3 from combustion and animal agriculture, and the return of these substances to the earth's surface by precipitation, aerosol impaction, and gas deposition. Of the 478 Gg N entering the terrestrial ecosystem annually, 275 Gg enters from the atmosphere. Of this amount, 158 Gg represents newly fixed nitrogen and 117 Gg is recycled from nitrogen already present in the system. Gas deposition appears to exceed precipitation as the dominant transfer mechanism by a factor of 1.7. As inputs of anthropogenic nitrogen to the atmosphere increase in response to growing power and protein demands, the importance of atmospheric nitrogen inputs may be expected to increase. The effects of atmospheric inputs on the nitrogen budget of a lake depends on the surface area of the lake and its watershed, its proximity to NO x sources and pastures, lake pH, and the nutrient biogeochemistry of surrounding terrestrial communities. Direct contributions to lake surfaces are generally less than 5% of the annual nitrogen inputs to lakes with measured nitrogen budgets. However, this value reflects the heavy hydrologic loading of nitrogen from intensive land use in the watershed of most Florida lakes. Lake Okeechobee and several smaller unimpacted lakes may receive over a third of their nitrogen inputs from the atmosphere. The extent to which atmospheric nitrogen deposition to terrestrial ecosystems is transported to lakes is unknown, but the proportion which is exported may be expected to increase as ecosystems become progressively less nitrogen-limited. (See also W87-09164) (Lantz-PTT)
W87-09176

USE OF BOG VEGETATION AS A MONITOR OF ATMOSPHERIC INPUT OF METALS,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 5C.
W87-09182

ATMOSPHERIC LEAD AND ZINC DEPOSITION INTO LAKES OF THE EASTERN UNITED STATES,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W87-09183

RATES OF ACCUMULATION OF HEAVY METALS IN PRE- AND POST-EUROPEAN SEDIMENTS IN NEW ENGLAND LAKES,
Maine Univ. at Orono. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W87-09184

ATMOSPHERIC CONCENTRATIONS AND DEPOSITION OF POLYCHLORINATED BIPHENYLS TO LAKE SUPERIOR,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
For primary bibliographic entry see Field 5B.
W87-09185

INPUTS OF POLYCHLORINATED BIPHENYLS FROM THE ATMOSPHERE TO LAKES HURON AND MICHIGAN,
De Paul Univ., Chicago, IL.
For primary bibliographic entry see Field 5B.
W87-09186

ATMOSPHERIC DEPOSITION OF PARTICULATE ORGANIC CARBON AND POLYAROMATIC HYDROCARBONS TO LAKE MICHIGAN,
Wisconsin Univ.-Madison. Water Chemistry Lab.
For primary bibliographic entry see Field 5B.
W87-09187

APPLIED STREAM SANITATION,
C. J. Velz.
Second Edition. John Wiley and Sons, New York, NY. 1984. 800 p.

Descriptors: *Streamflow, *Wastewater treatment, *Stream sanitation, *Sanitation, Water treatment, Radioactive wastes, Toxins, Thermal pollution, Water analysis, Polychlorinated biphenyls, Chlordane, Mathematical models.

The current status of the science and art of stream pollution control and water quality management is presented. The focus of the text is on practical methods of quantitative definition of waste assimilation capacity and resultant water quality in the environment of the actual river (or estuary). These in river self-purification reactions are shown to be unique to each type of waste, and subject to hydrologic and biologic variations. Methods of analysis are presented by which effectiveness of alternative solutions to pollution problems can be evaluated and judged. Separate chapters are devoted to self-purification of various types of wastes in freshwater streams: Organic, Microbial, Radioactive, Non-degradables, and Toxics, and Heat Dissipation. An additional chapter presents modifications for tidal estuaries. Recent findings documented by intensive stream analysis studies prompted the addition of three new chapters. Numerous illustrations drawn from actual river cases are included. These chapters cover: (1) Self-purification of nondegradable wastes - suspended matter, trace metals and other toxics such as PCB and Chlordane; (2) Evaluation of the impact of basinwide secondary biological treatment based on before and after intensive stream analysis studies; and (3) A comparative appraisal of theoretical mathematical modelling and rational assessment methods, and a format of requirements for development of an acceptable applied model. (Lantz-PTT)
W87-09189

THEORY OF FLUORESCENT IRRADIANCE FIELDS IN LAKES AND SEAS,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 5A.
W87-09193

HYDROLOGY AND DRAINAGE OF PEATLAND,
Foras Taluntais, Ballinrobe (Ireland).
For primary bibliographic entry see Field 2G.
W87-09201

HEAVY METALS DISTRIBUTION IN THE SEDIMENTS OF GANGES AND BRAHMAPUTRA RIVERS,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W87-09204

COMPARATIVE STUDY ON THE INTRINSIC RATES OF INCREASE OF CYRTOBAGOUS SINGULARIS AND C. SALVINIAE ON THE WATER WEED SALVINIA MOLESTA,
Expand CSIRO, Indooroopilly (Australia). Long Pocket Labs.
For primary bibliographic entry see Field 4A.
W87-09217

TROPHIC INTERACTIONS IN THE PLANKTON OF MALYI SEVAN IN JULY, 1984,

Akademiya Nauk SSSR, Leningrad. Zoological Inst.
B. L. Gutelmacher, and A. A. Simonyan.
Doklady Biological Sciences DKBSAS, Vol. 287, No. 1-6, p 153-155, March/April 1986. 1 fig, 1 tab, 5 ref. Translated from Doklady Akademii Nauk SSSR, Vol. 287, No. 2, p 498-501, March 1986.

Descriptors: *Plankton, *Zooplankton, *Crustaceans, *Phytoplankton, *Trophic level, Mountain lakes, Eutrophic lakes.

High-altitude Lake Sevan experienced a significant increase in biological productivity in the 1970s, reaching 720 g carbon/sq m/yr in 1977, highly eutrophic. In the early 1980s a significant drop in primary productivity occurred, reaching 200 g carbon/sq m/yr in 1983. The decreased rate of photosynthesis affected the structure and quantitative indices of all plankton components. At present a changeover of the dominant species is occurring almost yearly. Studies of the trophic interactions in Malyi Sevan were conducted in July, 1984. The objective was the study of the feeding characteristics of the major crustacean species and their influence on the phytoplankton. The phytoplankton consisted mainly of the filamentous green alga Binuclearia lauterbornii. Other species with small biomass were Ceratium hirundinella, Crucigenia quadrata, and several Anabaena species. Acanthodiaptomus denticornis and Daphnia longispina were added to experimental flasks. A threefold drop in the quantity of algae in a flask resulting from crustacean feeding did not lead to a significant decrease in primary production. With a higher content of crustaceans in the experimental vessels than found in nature, productivity remained at the same level due to the high photosynthetic rate of the remaining cells. The results obtained indicate the significant role played by planktonic animals in the stimulation of photosynthesis in planktonic algae, which they may affect not only under experimental, but also under natural conditions. (McFarlane-PTT)
W87-09219

SEASONAL DISTRIBUTION OF THERMOTOLERANT FREE-LIVING AMOEBAE. II. LAKE ISSAQUEENA,
Clemson Univ., SC. Dept. of Biological Sciences.
D. E. Kyle, and G. P. Noblet.
Journal of Protozoology JPROAR, Vol. 34, No. 1, p 10-15, February 1987. 9 fig, 6 ref.

Descriptors: *Limnology, *Lake Issaqueena, *Species composition, *Protozoa, *Thermal stress, Lakes, Monomictic lakes, Sediments, Aquatic habitats.

A quantitative study of the seasonal distribution of thermotolerant (37C and 45 C), small free-living amoebae (FLA) was conducted in Lake Issaqueena, a warm, monomictic lake with steep, sloping banks and a maximum basin depth of 10 m in the Piedmont region of South Carolina. Naegleria and Vahlkampfia were the most frequently encountered FLA in littoral sediment and surface water samples whereas Acanthamoeba was most commonly isolated from profundal sediment, especially during late summer. In the water column, FLA populations were highest in a persistent detrital layer; however, few amoebae were isolated from a massive (about 1.5 m thick) layer of Oscillatoria. The only N. fowleri isolated in this study was from the detrital layer. Discussion of the influence of differences in watershed and basin morphology on variations in the size and generic composition of FLA populations for the aquatic ecosystems of Lake Issaqueena and Willard's Pond is included. (Author's abstract)
W87-09225

ZINC, IRON, MANGANESE, AND MAGNESIUM ACCUMULATION IN CRAYFISH POPULATIONS NEAR COPPER - NICKEL SMELTERS AT SUDBURY, ONTARIO, CANADA,
Dept. of Biology, Laurentian Univ., Sudbury, Ontario P3E 2C6, Canada.
For primary bibliographic entry see Field 5C.
W87-09243

RESPONSE OF LAKE SEDIMENTS TO CHANGES IN TRACE METAL EMISSION FROM THE SMELTERS AT SUDBURY, ONTARIO,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W87-09245

FISH PREDATION ON JUVENILE BROWN SHRIMP, PENAEUS AZTECUS IVES: EFFECTS OF TURBIDITY AND SUBSTRATUM ON PREDATION RATES,
National Marine Fisheries Service, Galveston, TX. Galveston Lab.
T. J. Minello, R. J. Zimmerman, and E. X. Martinez.
Fishery Bulletin FSHBAY, Vol. 85, No. 1, p 59-70, January 1987. 2 fig, 6 tab, 51 ref.

Descriptors: *Fish predation, *Turbidity, *Shrimp, *Food habits, Flounder, Croaker, Pinfish, Fish behavior, Sand, Burrowing.

Predation on juvenile brown shrimp, Penaeus aztecus, by three species of estuarine fishes was examined in a series of laboratory experiments to determine the effect of turbid water and the presence of a suitable substratum for burrowing. Regardless of the type of substratum, turbid water increased predation by southern flounder, Paralichthys lethostigma, and decreased predation by Atlantic croaker, Micropogonias undulatus. In both clear and turbid water, the presence of sand, which allowed shrimp to burrow, decreased predation by southern flounder but had no significant effect on feeding rates of Atlantic croaker. There was a significant interaction between the effects of turbidity and substratum on predation by pinfish, Lagodon rhomboides. Turbid water decreased predation in tanks with hard substrata but had no significant effect in tanks with sand. The presence of sand reduced predation only in clear-water tanks. Burrowing by brown shrimp was reduced in turbid water which may explain this interaction. Overall, the data indicate that both turbid water and a suitable substratum for burrowing may reduce predation on brown shrimp, but the value of these refugia is highly dependent upon the species of predator. (Author's abstract)
W87-09252

SPRING AND SUMMER MOVEMENTS OF SUBADULT STRIPED BASS, MORONE SAXATILIS, IN THE CONNECTICUT RIVER,
Massachusetts Cooperative Fishery Research Unit. Univ. of Massachusetts, Holdsworth Hall, Amherst, MA 01003.
B. Kynard, and J. P. Warner.
Fishery Bulletin FSHBAY, Vol. 85, No. 1, p 143-147, January 1987. 2 fig, 14 ref. Federal Aid Project AFS-4-R-21 and Dingell-Johnson Project 5-29328.

Descriptors: *Temperature effects, *Bass, *Fish migration, *Connecticut River, Remote sensing, Fish behavior, Water temperature.

The Connecticut River has no known spawning population of striped bass, Morone saxatilis, but there is an annual run of subadults in the late spring and summer from Long Island Sound to Holyoke Dam, 140 km upstream. In 1980-82, 80-90% were age II (the remainder were age III); about 60% were males. The biological reason for such a run is unknown, but feeding may be an important attractant to the river. Detailed studies of subadult movements in the Connecticut River could help reveal some of the environmental factors that effect the movements. We used radio telemetry of subadults captured at Holyoke Dam to observe the use of river habitats, diel activity, and the rates of upstream and downward movements. We also investigated the passage of striped bass at the Holyoke fish lifts in relation to river temperature during 1979-1986. Based on the results of fish passage at Holyoke Dam, behavioral observations using telemetry, and the general thermal niche of subadults reported by Coutant and Carroll and Coutant, we hypothesize that the movement of subadult striped bass into the Connecticut River is due in part to thermal preferences. The upriver migration in May-July places subadults in temperatures closer to their preferred range than those found in Long Island Sound. Tracking of fish in the river indicates a diverse behavioral range of active swimming, resting, and feeding that is consistent with a spring-summer period of high activity and growth. Local attraction to dam tailwaters provides access to abundant food, a feature that reinforces the advantages of following thermal cues into the riverine environment. The feeding advantages for striped bass will likely increase as the restoration program for American shad and blue-back herring results in an increased abundance of juveniles. (Alexander-PTT)
W87-09253

MODELLING OF BOD-DO DYNAMICS IN AN ICE-COVERED RIVER IN NORTHERN CHINA,
Research Inst. of Environmental Science, Peking Normal Univ., Peking, China.
For primary bibliographic entry see Field 5B.
W87-09262

EFFECT OF BEAVER PONDS ON THE NONPOINT SOURCE WATER QUALITY OF A STREAM IN SOUTHWESTERN WYOMING,
Wyoming Univ., Laramie. Dept. of Zoology and Physiology.
T. J. Maret, M. Parker, and T. E. Fannin.
Water Research WATRAG, Vol. 21, No. 3, p 263-268, March 1987. 2 fig, 1 tab, 20 ref.

Descriptors: *Beaver ponds, *Water quality, *Currant Creek, *Nutrients, Runoff, Beaver dams, Watersheds, Agriculture, Channel erosion.

Currant Creek, a second order stream in southwestern Wyoming, has three large complexes of beaver ponds midway along its 32 km length. To determine whether these ponds improve the quality of water flowing through them samples were taken upstream from, within, and downstream from the pond complexes. During periods of high flow (i.e., spring runoff), concentrations of suspended solids (SS), total phosphorus (TP), sodium hydroxide-extractable phosphorus (NaOH-P, an index of biologically available P) and total Kjeldahl nitrogen (TKN) were reduced in water flowing through the beaver ponds. During low flow, beaver ponds had less effect on these parameters. Concentrations of nitrate nitrogen (NO_3-N) were reduced during both high and low flows, while concentrations of ortho-phosphate (ortho-P) did not appear to be affected by beaver ponds. Ammonia nitrogen almost always was at the limit of detection. Regression of NaOH-P versus (SS plus ortho-P) suggested that the primary source of NaOH-P was SS. In general, SS explained a large portion of the variation in TP, TKN, and NaOH-P, and often ortho-P was significantly correlated to TP. The increase in the concentration of most parameters below the area with dam complexes appears to reflect input from bank and channel erosion, and export of SS, TP, TKN and NO_3-N from beaver dam complexes was calculated to be less than that from stream sections above or below the dams. Thus the location of dams should be considered before using them to try and improve water quality. The apparent importance of bank and channel erosion as the primary source of nutrients to Currant Creek contrasts with many watersheds in agricultural areas. (Author's abstract)
W87-09265

DEGRADATION OF ANILINE AND CHLOROANILINES BY SUNLIGHT AND MICROBES IN ESTUARINE WATER,
Georgia Univ., Athens. Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W87-09271

COMPARISON OF TOXICITY TESTS CONDUCTED IN THE LABORATORY AND IN EXPERIMENTAL PONDS USING CADMIUM AND THE FATHEAD MINNOW (PIMEPHALES PROMELAS),
Cornell Univ., Ithaca, NY. Dept. of Natural Re-

sources.
For primary bibliographic entry see Field 5C.
W87-09272

DISTRIBUTION OF PARTICULATE MATTER IN RELATION TO THE THERMAL CYCLE IN LAKE VECHTEN (THE NETHERLANDS): THE SIGNIFICANCE OF TRANSPORTATION ALONG THE BOTTOM,
Limnological Inst., Vijverhof Lab., Rijksstraatweg 6, 3631 AC Nieuwersluis, The Netherlands.
H. Verdouw, H. J. Gons, and C. L. M. Steenbergen.
Water Research WATRAG, Vol. 21, No. 3, p 345-351, March 1987. 7 fig, 1 tab, 29 ref.

Descriptors: *Thermal stratification, *Limnology, *Lake Vechten, *Suspended solids, *Particulate matter, *Sediments, Thermal cycles, Water temperature, Transport.

Throughout the thermal cycle of Lake Vechten (The Netherlands) the concentrations and chemical composition of particulate matter suspended in the water, deposited on the bottom near the shore and collected in sediment traps was measured. With regard to the distribution of particulate matter two significant periods during the thermal cycle could be distinguished. From May till mid-August a temperature gradient was present in the water column. During that period the average rate of increase in dry weight of bottom deposits and the sedimentation rate on that location were similar, i.e., lake wide 1.5 and 1.7 g/sq m respectively. This indicates a dominating role of settling particles in the building-up of the temporary shallow sediment, which resulted in the typical summer maximum of nearly 145 g/sq m. From mid-August onwards the concentration of this sediment zone decreased sharply coinciding with the disappearance of the temperature gradient. This removal was explained by the mechanism of enhanced turbulence, occurring when thermal homogeneity was reached, which initiated resuspension and subsequent transportation of the particles to greater depths. From light profiles it was inferred that the flux of particles was confined largely to the water layer of 1 m near the bottom. From comparison of the sedimentation rate in the central part of the lake with that in the shallow zone it could be estimated that compared to the particle flux in the open water towards profundal sediments, the flux along the bottom amounted during the thermal stratification period to an average of at least 42%. (Author's abstract)
W87-09275

HYDROLOGICAL AND CHEMICAL FACTORS CONTROLLING THE CONCENTRATIONS OF FE, CU, ZN AND AS IN A RIVER SYSTEM CONTAMINATED BY ACID MINE DRAINAGE,
Applied Geochemistry Research Group, Royal School of Mines, Imperial Coll., London SW7.
For primary bibliographic entry see Field 5B.
W87-09277

POWER-PLANT-RELATED ESTUARINE ZOOPLANKTON STUDIES,
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
For primary bibliographic entry see Field 5C.
W87-09316

EFFECTS OF COPPER ON THE PERIPHYTON OF A SMALL CALCAREOUS STREAM,
Environmental Monitoring and Support Lab.-Cincinnati, OH. Biological Methods Branch.
For primary bibliographic entry see Field 5C.
W87-09318

STATISTICAL TECHNIQUES FOR EVALUATING PROCEDURES AND RESULTS FOR PERIPHYTON SAMPLING,
Water and Air Research, Inc., Gainesville, FL.
For primary bibliographic entry see Field 7C.
W87-09319

IMPACT OF TRINITROTOLUENE WASTEWATERS ON AQUATIC BIOTA IN LAKE CHICKAMAUGA, TENNESSEE,
Water and Air Research, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5C.
W87-09322

ESTABLISHMENT OF BIOTIC COMMUNITIES WITHIN A NEWLY CONSTRUCTED ASH SETTLING BASIN AND ITS DRAINAGE SYSTEM,
Texas Univ. Health Science Center at Houston. School of Public Health.
For primary bibliographic entry see Field 5E.
W87-09323

PLANTS AND PEAT CUTTINGS: HISTORICAL ECOLOGY OF A MUCH EXPLOITED PEAT LAND-THORNE WASTE, YORKSHIRE, UK,
The University, Sheffield (England). Dept. of Botany.
For primary bibliographic entry see Field 4C.
W87-09342

EVALUATIONS OF THE RECREATIONAL POTENTIAL OF RESERVOIRS IN DESIGN PRACTICE,
A. B. Avakyan, V. K. Boichenko, and V. P. Saltankin.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 7, p 421-425, July 1986. 3 tab, 5 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 30-33, July 1986.

Descriptors: *Recreation, *Reservoirs, *Design criteria, Multipurpose reservoirs, USSR.

The recreational use of reservoirs is acquiring an ever greater scale and development. Almost 80 million people in the USSR use reservoirs for brief or long, organized or independent recreation. One of the most important problems, especially in a practical respect, is the development of measures to increase the effectiveness of the recreational use of reservoirs and determination of the permissible extent of development of individual types of recreation. This report used simple grading point evaluations of the limiting factors of recreational water use, making it possible to obtain a realistic picture of the possible extent of development of recreation and sports of the population and to correctly plan the composition, sequence, and volume of appropriate measures. (Ram-PTT)
W87-09360

DEPENDENCE OF RIVER POLLUTION ON STREAMFLOW REGULATION BY RESERVOIRS,
For primary bibliographic entry see Field 5G.
W87-09361

LABORATORY AND INSTREAM NITRIFICATION RATES FOR SELECTED STREAMS,
Environmental Protection Agency, Athens, GA.
S. McCatcheon.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 3, p 628-646, June 1987. 6 fig, 3 tab, 29 ref.

Descriptors: *Model studies, *Nitrification, *Biochemical oxygen demand, *Rivers, Flow, Velocity, Nitrogen, Performance evaluation, Calibrations.

Nitrification rate coefficients are predicted from biochemical oxygen demand tests for two rivers that are moderately deep but have some shoals and riffles. The two streams studied are notable for the lack of a thick benthic community and for the low flow velocities. Measured nitrification coefficients are compared to independently derived coefficients from calibrated first-order, nitrification models of the Chattahoochee River in Georgia and the West Fork Trinity River in Texas. For the Chattahoochee River, the model calibration coefficient at 20 C is 0.25/day compared to a laboratory measurement of 0.26/day. The model calibration coefficient is 0.52/day for the West Fork Trinity River compared to the laboratory measurement of 0.50/day. For both river studies, sufficient evidence is available to indicate that the nitrification models adequately separate nitrification from other processes that transform nitrogen. (Author's abstract)
W87-09378

EFFECTS OF INTERMITTENT EXPOSURE TO SUSPENDED SOLIDS AND TURBULENCE ON THREE SPECIES OF FRESHWATER MUSSELS,
Dept. of Biology, North Carolina Agricultural and Technical State Univ., Greensboro, NC 27411, USA.
For primary bibliographic entry see Field 6G.
W87-09381

SCANNING CURRENTS IN STOKES FLOW AND THE EFFICIENT FEEDING OF SMALL ORGANISMS,
New York Univ., NY. Courant Inst. of Mathematical Sciences.
S. Childress, M. A. R. Koehl, and M. Miksis.
Journal of Fluid Mechanics JFLSA7, Vol. 177, p 407-436, April 1987. 9 fig, 27 ref, 2 append. NSF Contracts DMS-831 2229, OCE-820 1395, OCE-851 0834 and DMS-840 3186; SERC (England) Grant GR/DS/13573.

Descriptors: *Data interpretation, *Hydrodynamics, *Food habits, *Currents, *Model studies, Aquatic life, Swimming, Amplitude.

The feeding behavior of many small, free-swimming organisms involves the creation of a scanning current by the coordinated movement of a group of appendages. In this paper, we study the generation of scanning currents in Stokes flow in a number of simple models, utilizing the movement of Stokeslets, spheres, or stalks to set up an average scanning drift in a suitable far-field formulation. Various mechanisms may then be classified by the rate of decay at infinity of the mean scanning current. In addition, optimal scanning can be investigated by minimizing the mean power required to create a current of prescribed amplitude. The simple mechanisms for scanning described here provide a framework within which the appendage movements of small aquatic organisms can be analyzed and the relative merits of scanning and swimming strategies can be investigated. (Author's abstract)
W87-09385

USE OF MONODISPERSED, FLUORESCENTLY LABELED BACTERIA TO ESTIMATE IN SITU PROTOZOAN BACTERIVORY,
Georgia Univ., Sapelo Island. Marine Inst.
B. F. Sherr, E. B. Sherr, and R. D. Fallon.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 5, p 958-965, May 1987. 8 fig, 1 tab, 30 ref.

Descriptors: *Limnology, *Estuaries, *Food habits, *Analytical methods, *Fluorescence, *Bacteria, *Bacterivory, *Protozoa, Metabolism, Toxicity, Growth rate, Grazing, Estimating.

A procedure for preparing monodispersed, fluorescently labeled bacteria (FLB), which may be used to measure virtually instantaneous rates of protozoan bacterivory in natural waters was developed. FLB can be prepared both from natural bacterioplankton assemblages and from clonal isolates and can be stored in frozen suspension or freeze-dried without apparent loss of fluorescence intensity. They are not toxic to protozoan and can be metabolized to support bacterivorous protozoan growth rates equal to those on the same strain of unstained, viable bacteria. In experiments comparing uptake of FLB with uptake of fluorescent latex microspheres by protozoan assemblages in a salt marsh tidal creek, we found that both pelagic oligotrichous ciliates and phagotrophic flagellates ingested FLB with a frequency 4- to 10-fold greater than they ingested the microspheres. Consequently, it appears that the use of latex microspheres leads to underestimation of protozoan bacterivory and that the FLB technique is superior for estimating in-

stantaneous rates of in situ protozoan grazing on bacterioplankton. (Author's abstract)
W87-09388

POTENTIAL FOR TRANSDUCTION OF PLASMIDS IN A NATURAL FRESHWATER ENVIRONMENT: EFFECT OF PLASMID DONOR CONCENTRATION AND A NATURAL MICROBIAL COMMUNITY ON TRANSDUCTION IN PSEUDOMONAS AERUGINOSA,
Dept. of Biochemistry and Biophysics, Stritch School of Medicine, Loyola Univ. of Chicago, Maywood, IL 60153.
D. J. Saye, O. Ogunseitan, G. S. Sayler, and R. V. Miller.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 5, p 987-995, May 1987. 7 fig, 6 tab, 28 ref.

Descriptors: *Transduction, *Pseudomonas, *Plasmids, *Natural water, *Microbiological studies, Reservoirs, Growth rate, Aquatic environment.

Transduction of Pseudomonas aeruginosa plasmid Rms149 by the generalized transducing bacteriophage PhiDS1 was shown to occur during a 9-day incubation of environmental test chambers in a freshwater reservoir. Plasmid DNA was transferred from a nonlysogenic plasmid donor to a PhiDS1 lysogen of P. aeruginosa that served both as the source of the transducing phage and as the recipient of the plasmid DNA. When the concentration of donors introduced into the chambers was varied while the recipient concentration in each chamber was at a level equivalent to natural concentrations of P. aeruginosa, the concentration of plasmid-containing donor cells introduced was shown to affect the frequency of transduction significantly. Transduction was observed both in the absence and in the presence of the natural microbial community. The presence of the natural community resulted in a rapid decrease in the numbers of the introduced donors and recipients and a decrease in the number of transductants recovered. These results demonstrate the potential for naturally occurring transduction in aquatic environments and indicate that donor load may be an important parameter in assessing this potential. (Author's abstract)
W87-09390

DISTRIBUTION OF PROTOZOA IN SUBSURFACE SEDIMENTS OF A PRISTINE GROUNDWATER STUDY SITE IN OKLAHOMA,
Dept. of Microbiology, Cornell Univ., Ithaca, NY 14853.
J. L. Sinclair, and W. C. Ghiorse.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 5, p 1157-1163, May 1987. 4 fig, 2 tab, 30 ref. EPA Cooperative agreement CR811148.

Descriptors: *Sediments, *Groundwater, *Protozoa, *Species composition, *Population dynamics, Clay, Amoebae, Oklahoma.

Sediment core samples were obtained at a groundwater study site in Oklahoma in January and June 1985. Most-probable-number estimates showed that protozoan numbers declined steeply with depth in subsoil. Flagellates and amoebae dominated the protozoan population, which declined to a most probable number of 28/g (dry wt) in a clay loam layer at the bottom of the unsaturated zone. Samples from a texturally variable interface zone between 3 and 4 m down also were variable in their content of protozoa. Four contiguous clay loam samples in a single core from this zone contained variable numbers of amoebae ranging from 0.2 to 44/g (dry wt). However, sandy clay loam layer at the bottom of the core contained a mixture of flagellates and amoebae with a combined population density of 67/g (dry wt). A slow-growing filose amoeba was isolated from interface zone samples and was tentatively classified in a new family in the order Aconchulinida. Protozoa were not detected in the saturated zone except in a very permeable gravelly, loamy sand layer at a depth of approximately 7.5 m. Low numbers (4 to 6/g (dry wt)) of surface-type flagellates and amoebae, as well as the filose amoeba seen in the interface zone, were observed in this layer. Acid-treated and untreated samples contained equivalent numbers of protozoa, showing that the majority of protozoa in the layer at 7.5 m and the interface zone samples were encysted. Increased numbers of bacteria also were found in the layer at 7.5 m, indicating that it was biologically more active than other saturated-zone layers. Cyanobacteria grew in illuminated samples from this layer, suggesting that it may be connected hydrologically to a nearby river. (Author's abstract)
W87-09395

INFLUENCE OF SUBSTRATE STABILITY ON THE COMPOSITION OF STREAM BENTHOS: AN EXPERIMENTAL STUDY,
Dept. of Ecology, Univ. of Lund, Ecology Building, S-223 62 Lund, Sweden.
B. Malmqvist, and C. Otto.
Oikos OIKSAA, Vol. 48, No. 1, p 33-38, January 1987. 3 fig, 6 tab, 31 ref.

Descriptors: *Substrate stability, *Species composition, *Streams, *Invertebrates, Insects, Benthos, Density, Artificial substrates, Sweden.

Artificial stones having identical surface area and complexity, but different specific densities, were placed in four Swedish stream riffles. The rate of movement of stones was assumed to be related to their density. Invertebrate colonization showed indications in agreement with the intermediate disturbance hypothesis although these were weak and not conclusive. More significant positive (22 and 38%) and negative (16 and 11%) correlations among pairs of the most common species were found in two of the streams than would have been expected by chance alone (2.5%) suggesting biotic interactions. In general, blackfly number positively correlated to species richness, and this correlation was probably related to the structuring effect of the cocoons of Prosimulium hirtipes which resemble moss. While some species (e.g., Eusimulium cryophilum and Polypedilum laetum) dominated the lightest artificial stones, others showed higher incidences on stones of intermediate (e.g., Agapetus ochripes, Hydropsyche siltalai and Polycentropus flavomaculatus) or high densities (e.g. Gammarus pulex and Rheotanytarsus spp.). These patterns may be interpreted as interspecific differences in colonization abilities or strategies. (Author's abstract)
W87-09403

ENHANCEMENT OF INORGANIC NITROGEN AND PHOSPHATE RELEASE FROM LAKE SEDIMENT BY TUBIFICID WORMS AND CHIRONOMID LARVAE,
Faculty of Education, Niigata Univ., Ikarashi 2-8050, Niigata, Japan, 950-21. M. Sakamoto, Water Res. Inst., Nagoya Univ., Chikusa-ku, Nagoya, Japan, 464.
H. Fukuhara, and M. Sakamoto.
Oikos OIKSAA, Vol. 48, No. 3, p 312-320, March 1987. 6 fig, 5 tab, 40 ref. Ministry of Education, Science and Culture, Japan. Grant-in-Aid 503040.

Descriptors: *Lake sediments, *Chironomid larvae, *Nitrogen, *Phosphorus, *Turbificids, Ammonium, Nutrients, Lakes, Phosphates, Bioturbation.

The effects of chironomid larvae and tubificid worms on the release of inorganic nitrogen and phosphorus from a eutrophic freshwater lake sediment were evaluated experimentally using mud-water microcosms. The larvae of Chironomus plumosus L. and Limnodrilus spp. caused an enhancement of inorganic nitrogen release (mainly ammonium nitrogen) from lake sediment. Increasing densities of tubificids markedly influenced release rates. Apparent diffusion coefficients of ammonium at the mud-water interface in microcosms with Limnodrilus spp. increased from .000035 to .00024 sq cm/s over a range of 5 densities from 0 to 72500 worms/sq m, while that for microcosms with C. plumosus increased from .000026 to .00048 sq cm/s over a range of 5 densities from 0 to 6800 larvae/sq m. Chironomids and tubificids also had an accelerating effect on phosphate release. Phosphate release rates became greater with an increasing density of organisms. Chironomids induced some enhancement of the release rate at low densities but caused a suppression at high densities. The excretion: release ratios indicated the importance of bioturbation for ammonium release and the importance of excretion for phosphate release. (Author's abstract)
W87-09404

EFFECTS OF POLLUTION BY ORGANIC SUGAR MILL EFFLUENT ON THE MACROINVERTEBRATES OF A STREAM IN TROPICAL QUEENSLAND, AUSTRALIA,
Dept. of Zoology, James Cook Univ. of North Queensland, Queensland 4811, Australia.
For primary bibliographic entry see Field 5C.
W87-09421

LIMNOLOGICAL INVESTIGATIONS: LAKE KOOCANUSA, MONTANA; PART 3: BASIC DATA, POST-IMPOUNDMENT, 1972-1978,
Corps of Engineers, Seattle, WA. Seattle District.
P. C. Storm, T. J. H. Bonde, R. M. Bush, and J. W. Helms.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-124454, A99 in paper copy, A01 in microfiche. Special Report 82-83, November 1982. 597 p, 15 fig, 159 tab, 8 ref.

Descriptors: *Reservoirs, *Water quality management, *Limnology, *Montana, Water quality, Lake morphology, Bacterial analysis, Chemical analysis, Water analysis, Chemical composition, Nutrients, Lake Koocanusa.

Water quality limnological data compiled from 1972 through 1978 are presented. The study of Lake Koocanusa, Montana, the reservoir formed by impoundment of the Kootenai River, was undertaken in 1972 as a continuation of preimpoundment studies underway since 1967. Data were collected primarily by the Corps of Engineers, however, additional information was provided by the British Columbia Ministry of the Environment, Waste Management Branch, and the Water Survey of Canada. The data on such parameters as temperature, dissolved oxygen, nutrient loading, discharge rates, bacteria levels, trace metals, turbidity, gas saturation levels, and major cations and anions are presented in tabular form. (Halterman-PTT)
W87-09463

VULNERABILITY OF SELECTED LAKES AND STREAMS IN THE MIDDLE ATLANTIC REGION TO ACIDIFICATION: A REGIONAL SURVEY,
Pennsylvania Cooperative Fish and Wildlife Research Unit, University Park.
For primary bibliographic entry see Field 5B.
W87-09476

EFFECTS OF STORAGE REALLOCATION ON THERMAL CHARACTERISTICS OF COWANESQUE LAKE, PENNSYLVANIA: NUMERICAL MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
J. P. Holland.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA118007, A06 in paper copy, A01 in microfiche. Technical Report HL-82-9, April 1982. Final Report. 116 p, 2 fig, 5 tab, 5 plates, 6 ref, 2 append.

Descriptors: *Lakes, *Numerical analysis, *Mathematical models, *Thermal stratification, *Water supply, *Temperature control, *Water temperature, *Project planning, Models, Model studies, Water storage, Selective withdrawal.

Growing consumptive use of water in the Susquehanna River Basin has prompted U.S. Army Engineer District, Baltimore, to examine the feasibility of reallocating a portion of flood-control storage of Cowanesque Lake to water supply storage. This reallocation would result in increases to normal pool elevation which may alter the thermal struc-

ture of the lake and render the present selective withdrawal system inadequate for release temperature maintenance. A one-dimensional numerical model was used to evaluate the ability of the present selective withdrawal system to meet release temperature objectives for three proposed increased pool elevations for four study years. Subsequently, the one-dimensional numerical model was coupled with numerical optimization routine to provide estimates for the location of additional selective withdrawal intakes required to meet specified release temperature objectives for the higher normal pools. It was determined that four additional selective withdrawal intakes would be required to provide the flexibility necessary to maintain downstream temperature objectives. Furthermore, the additional ports, (6 ft wide by 7 ft high) should be larger than the existing ports (5 ft by 5 ft) to ensure that the intakes can pass flow at a rate equal to the capacity of the wet wells. (Author's abstract)
W87-09485

2I. Water In Plants

INTERCEPTION LOSSES OF RAINFALL FROM CASHEW TREES,
Centre for Water Resources Development and Management, Calicut (India). Water Management (Ag) Division.
A. S. Rao.
Journal of Hydrology JHYDA7, Vol. 90, No. 3/4, p 293-301, April 1987. 2 fig, 2 tab, 13 ref.

Descriptors: *Rainfall-runoff relationships, *Rainfall interception, *Cashew trees, *Canopy, *Tropical regions, *Interception, *Throughfall, India, Storms, Rainfall, Model studies, Prediction.

Rainfall interception losses from Cashew trees were quantified, based on the records of 105 selected storms within the range < or = 25.0 mm, occurring in a humid tropical region at Kottamparamba, India. The storage capacity of the Cashew trees was worked out as 0.8 mm and the throughfall coefficient as 0.391. The trees under observations were 15-20 years of age with a leaf area index of 1.0-1.25. About 31% of the storm rainfall for storms < or = 25.0 mm was intercepted by the Cashew trees and lost to the atmosphere. The measured interception losses from trees were compared with the estimated interception losses using the analytical model of Gash (1979). The predicted interception losses from the Cashew trees were within + or - 10% for storms with total rainfall < or = 10.0 mm and within + or - 22% for storms with a rainfall of 10.1-25.0 mm. (Author's abstract)
W87-08621

INFLUENCE OF SOIL WATER CONTENT ON THE SUPPLY OF PHOSPHATE TO PLANTS,
Department of Scientific and Industrial Research, Palmerston (New Zealand). Grasslands Div.
M. C. H. Mouat, and P. Nes.
Australian Journal of Soil Research ASORAB, Vol. 24, No. 3, p 435-440, 1986. 3 fig, 17 ref.

Descriptors: *Nutrients, *Soil water, *Plant water use, *Phosphates, Adsorption, Fertilizers, Bioaccumulation, Irrigation.

Ryegrass (Lolium perenne L.) was grown in a pot trial in soil of high phosphate adsorption capacity at 10 levels of P-supply and at two water regimes, one regularly adjusted to the water-holding capacity of the pots corresponding to a water potential of -2 to -3 kPa, and the other at 20% less water volume corresponding to -20 kPa. P uptake was lower in the lower water treatment at all P-supply levels, even when the P-supply was severely limiting P uptake. This reduction in P uptake at all P levels was equivalent to the reduction in water volume between the two water treatments, and is apparently a result of a lower supply of solution phosphate in the lower water treatment in the highly buffered soil. (Author's abstract)
W87-08705

INFLUENCE OF SULFUR GAS ON WATER LOSS RATE,
I. A. Smirov.
Soviet Journal of Ecology SJECAH, Vol. 17, No. 3, p 128-132, January 1987. 4 tab, 13 ref. Translated from Ekologiya, No. 3, p 19-23, May-June 1986.

Descriptors: *Air pollution effects, *Sulfur gas, *Plant water use, *Transpiration rate, Trees, Shrubs, USSR, Desert, Arid lands, Gases.

The influence of sulfur gas on the summer and winter transpiration rates of four species of tree and shrub was studied under typical Central Kazakhstan desert conditions. The changes in this indicator in the gas-contaminated atmosphere were established, as were the plant characteristics which help them to adapt to this unfavorable factor. (Author's abstract)
W87-08707

VEGETATION OF THE LOW-SHRUB BOGS OF NORTHERN NEW JERSEY AND ADJACENT NEW YORK: ECOSYSTEMS AT THEIR SOUTHERN LIMIT,
Bergen Community Coll., Paramus, NJ. Div. of Natural Sciences and Mathematics.
For primary bibliographic entry see Field 2H.
W87-08715

WATER PRODUCTION FUNCTIONS FOR WHEAT UNDER DIFFERENT ENVIRONMENTAL CONDITIONS,
J. N. Agricultural Univ., Madhya Pradesh (India). Coll. of Agriculture.
For primary bibliographic entry see Field 3F.
W87-08748

WATER USE OF EUCALYPTS - A REVIEW WITH SPECIAL REFERENCE TO SOUTH INDIA,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 6G.
W87-08749

EFFECTS OF WATER STRESS ON FLOWERING AND FRUIT SET IN PROCESSING-TOMATOES,
Lake Chad Research Inst., Maiduguri (Nigeria).
B. B. Wudiri, and D. W. Henderson.
Scientia Horticulturae SHRTAH, Vol. 27, No. 3/4, p 189-198, December 1985. 4 fig, 4 tab, 14 ref.

Descriptors: *Water stress, *Tomatoes, *Food crops, *Plant water use, Evapotranspiration, Reproduction, Fruit, Leaves, Drought, Field tests.

Experiments were conducted in a greenhouse and in the field to study the effects of water stress, imposed during the reproductive stage, on flowering and fruit set in two processing-tomatoe cultivars (Lycopersicon lycopersicon (L.) Karst, ex. Farw.). 'Saladette' is a determinate cultivar of compact non-branching growth habit, well adapted to high temperatures and dry conditions, while 'VF145B-7879' is a semi-determinate cultivar with a branching habit. The treatments consisted of applying 100, 75, 50 or 25% of control evapotranspiration (ET) in a completely randomized way with 12 replications. The effects of water stress on the reproductive processes were more pronounced in 'VF145B-7879' than in 'Saladette'. For example, severe water stress (25% ET) reduced fruit set by more than 90% in 'VF145B-7879' compared to a reduction of 40% in 'Saladette', which was found to perform better under the same degree of water stress because of its ability to roll its leaves under high evaporative demand, thereby maintaining high leaf water status - a sort of drought avoidance. (Author's abstract)
W87-08770

FIELD WATER RELATIONS OF A COMPASS PLANT, LACTUCA SERRIOLA L.,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl Pflanzenokologie.
K. S. Werk, and J. Ehleringer.
Plant, Cell and Environment PLCEDV, Vol. 9, No. 8, p 681-683, November 1986. 3 fig, 15 ref.

Descriptors: *Compass plant, *Plant water use, *Lactuca, *Leaves, *Water potentials, *Transpiration, Solar radiation, Temporal variation.

Field water relations of Lactuca serriola serriola and L. serriola integrifolia were examined. Leaf conductance to water vapor was high early in the morning and declined rapidly during the midday hours. Leaf water potentials decreased to their minima early in the morning and remained low all day. Afternoon recovery of leaf conductance occurred occasionally. Leaf conductance was shown to have a linear response to vapor concentration difference. No differences were seen between L. serriola serriola and L. serriola integrifolia. The pattern of diurnal gas-exchange activity appeared to be complemented by the pattern of intercepted solar irradiance which results from the compass plant leaf orientation observed L. serriola. (Author's abstract)
W87-08772

MODEL FOR PREDICTING THE INFLUENCE OF MOISTURE STRESS ON CROP LOSSES CAUSED BY OZONE,
Portland Univ., Oregon. Dept. of Physical and Life Sciences.
D. A. King.
Ecological Modelling ECMODT, Vol. 35, No. 1/2, p 29-44, February 1987. 4 fig, 3 tab, 32 ref.

Descriptors: *Air pollution effects, *Transpiration, *Moisture stress, *Crop yield, *Ozone, *Model studies, Moisture availability, Moisture deficiency, Drought, Stress, Mathematical models, Mathematical equations, Mathematical studies, Dry matter, Seasonal variation, Weather, Soybeans, Corn belt.

Estimates of crop losses caused by ambient ozone are usually based on results from fumigation experiments performed on adequately watered crops. However, drought frequently affects crop growth, and moisture stress was found to retard the appearance of ozone injury. To evaluate the effect of drought, a model was constructed that computes the influence of moisture stress on yield losses caused by ozone. The model calculates dry matter yield as the product of seasonal transpiration and transpiration efficiency (yield/transpiration) and incorporates current knowledge of the interaction between moisture stress and ozone. By simulating the progression of ozone effects and water use throughout the season, the model predicts relative yield for any given pattern of weather and ozone exposure. The model was calibrated and run for soybean (Glycine max (L.) Merr.) using soil characteristics, weather, and ozone inputs from the Corn Belt states (Illinois, Indiana, Iowa, Missouri, and Ohio). Reductions in the losses caused by ozone were predicted compared to those expected for adequately watered soybean. The results also indicate that declines in transpiration associated with ozone damage may influence the ozone x water stress interaction. (Author's abstract)
W87-08783

QUALITATIVE MODEL OF EUTROPHICATION IN MACROPHYTE LAKES,
Academy of Sciences, Moscow (USSR). Lab. of Mathematical Ecology.
For primary bibliographic entry see Field 2H.
W87-08785

ECOLOGICAL MODELLING OF A HIGH MOUNTAIN RESERVOIR IN RELATION TO PARTICULATE ORGANIC MATTER LOADING,
Savoie Univ., Chambery (France). Lab. de Biologie.
For primary bibliographic entry see Field 2H.
W87-08786

USE OF CANOPY TEMPERATURES TO IDENTIFY WATER CONSERVATION IN COTTON GERMPLASM,
Agricultural Research Service, Lubbock, TX. Plant and Water Conservation Research Unit.
For primary bibliographic entry see Field 3F.
W87-08788

IMPACT OF SIMULATED ACIDIC PRECIPITATION ON QUANTITY AND QUALITY OF A FIELD GROWN POTATO CROP,
Pennsylvania State Univ., University Park. Dept. of Plant Pathology.
For primary bibliographic entry see Field 5C.
W87-08789

CATCHMENT EFFECTS ON THE HORIZONTAL DISTRIBUTION OF PHYTOPLANKTON IN FIVE OF SCOTLAND'S LARGEST FRESHWATER LOCHS,
Institute of Terrestrial Ecology, Edinburgh (Scotland).
For primary bibliographic entry see Field 2H.
W87-08790

TEMPERATURE MODELLING OF WET AND DRY DESERT SOILS,
California Univ., Los Angeles. Dept. of Biology.
For primary bibliographic entry see Field 2G.
W87-08791

EFFECTS OF FLOODING, TILTING OF STEMS, AND ETHREL APPLICATION ON GROWTH, STEM ANATOMY AND ETHYLENE PRODUCTION OF PINUS DENSIFLORA SEEDLINGS,
Wisconsin-Madison Univ. Dept. of Forestry.
F. Yamamoto, and T. T. Kozlowski.
Journal of Experimental Botany, Vol. 38, No. 187, p 293-310. February 1987. 7 fig, 6 tab, 54 ref.

Descriptors: *Ethrel, *Plant growth, *Plant physiology, *Flooding, *Growth rates, Seedlings, Plant tissues.

Flooding of soil, tilting of seedlings, application of ethrel to stems, and combinations of these treatments, variously altered the rate of growth and stem anatomy of 2-year-old Pinus densiflora seedlings. Either flooding or tilting increased stem diameter growth and induced formation of abnormal xylem. Whereas flooding decreased the rate of dry weight increment of roots and needles and increased growth of bark tissues, tilting of stems did not. However, tilting decreased the rate of height growth, stimulated tracheid production, and induced formation of well-developed compression wood with rounded, thick-walled tracheids, with a high lignin content but without an S3 layer in the tracheid wall. Ethylene appeared to have an important regulatory role in stimulating growth of bark tissues as shown by thicker bark in flooded seedlings or those treated with ethrel. Ethylene appeared to have a less important role in regulating formation of compression wood. Flooding increased the ethylene contents of stems and induced formation of rounded, thick-walled tracheids. However, these tracheids lacked such features of well-developed compression wood tracheids as a thick S2 layer, high lignin content, and absence of an S3 layer. Furthermore, application of ethrel to vertical stems greatly increased their ethylene contents but did not induce formation of well-developed compression wood. Furthermore, ethrel application blocked development of certain characteristics of compression wood when applied to tilted seedlings. For example, an S3 wall layer was absent in tracheids of tilted seedlings but was present in tracheids of tilted, ethrel-treated seedlings. Also lignification of tracheids was increased on the under side of tilted stems, but reduced in tilted, ethrel-treated seedlings, further de-emphasizing a direct role of ethylene in the formation of compression wood. Ethrel treatment induced formation of longitudinal resin ducts in the xylem whereas flooding or tilting of stems did not. (Author's abstract)
W87-08797

NITROGENASE ACTIVITY, PHOTOSYNTHESIS AND NODULE WATER POTENTIAL IN SOYABEAN PLANTS EXPERIENCING WATER DEPRIVATION,
Animal and Grassland Research Inst., Hurley (England).
J.-L. Durand, J. E. Sheehy, and F. R. Minchin.
Journal of Experimental Botany, Vol. 38, No. 187, p 311-321. February 1987. 9 fig, 2 tab, 26 ref.

Descriptors: *Water deficit, *Water stress, *Drought, *Soybeans, *Plant physiology, Enzymes, Water potentials, Plant water potential, Stress, Photosynthesis, Nitrogen fixation, Psychrometers.

The effects of water deprivation on the activity of nodules of soyabean (Glycine max) were investigated in controlled environments. The water potential of detached nodules was measured using a Wescor psychrometer and a specially designed ten chamber psychrometer; each chamber was capable of holding up to six nodules which allowed for simultaneous measurements of between ten and 60 nodules. Nitrogenase activity (acetylene reduction) and respiration of intact, undisturbed nodulated roots was measured in a flow-through gas system. The equilibrium pattern of single nodules in a Wescor chamber showed a distinct biphasic pattern. Differences between the psuedo- and the true equilibrium values of water potential suggest that water potential gradients close to 0.1 MPa exist within the nodule tissue. Such gradients probably reflect histological discontinuities. When detached nodules dried, decreases in water potential and diameter were accompanied by increases in the resistance of water vapor loss through diffusion. These changes provide evidence for anatomical modifications which might provide some regulation of water loss. During a 7-day period of water deprivation there was a close relationship between decreases in leaf and nodule water potential. Nitrogenase activity showed a 70% decrease during the first 4 days, while photosynthesis only declined by 5%. It is suggested that water stress exerts an influence on nitrogenase activity which is independent of the rate of photosynthesis; it acts directly on nodule activity through increases in the resistance to oxygen diffusion to the bacteroids. The data suggest that the linear relationship between oxygen diffusion resistance and water potential is more important than any reductions in photosynthate supply. (Author's abstract)
W87-08798

ESTABLISHING SMOOTH CORDGRASS IN TIDAL WETLANDS,
Delaware Dept. of Transportation, Dover.
S. J. Lesley.
Public Works PUWOAH, Vol. 118, No. 3, p 61-62, March 1987. 3 ref.

Descriptors: *Smooth Cordgrass, *Grasses, *Wetlands, *Planting management, *Tide lands, St. Jones River, Delaware, Flood plains, Seeds, Seedlings, Herbicides, Economic aspects, Costs.

The possible establishment of Smooth Cordgrass, a perennial, rhizomatous plant typically encountered in the tidal floodplain of the St. Jones River in Delaware, by direct seeding, transplanting, and planting was evaluated for use after excavation of an old causeway in the site's restoration to wetlands. Ground preparation, planting criteria, and the seedling raising program were described. The herbicide, Glyphosate, was applied to control Common Reed to keep it from encroaching on the excavation site. Cost of seeding the area was detailed. It was found that Smooth Cordgrass can be established successfully by direct seeding or by planting of nursery-grown seedlings. Given the proper elevation and drainage conditions, continued research into the rate of volunteer Smooth Cordgrass seedling establishment is suggested to determine if a satisfactory stand can be achieved, given the presence of less desirable, but highly invasive forms of vegetation. (Wood-PTT)
W87-08806

ESTIMATION OF CANOPY RESERVOIR CAPACITY AND OXYGEN-18 FRACTIONATION IN THROUGHFALL IN A PINE FOREST,
Uppsala Univ. (Sweden). Div. of Hydrology.
For primary bibliographic entry see Field 2B.
W87-08814

SPATIAL VARIABILITY OF SOIL WATER AND EVAPOTRANSPIRATION,
Royal Veterinary and Agricultural Univ., Copenhagen (Denmark). Dept. of Soil and Water and Plant Nutrition.
For primary bibliographic entry see Field 2G.
W87-08815

REGULATION OF SUBMERGED AQUATIC PLANT DISTRIBUTION IN A UNIFORM AREA OF A WEEDBED,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W87-08836

LEAF THICKNESS AND WATER DEFICIT IN PLANTS: A TOOL FOR FIELD STUDIES,
Dept. of Applied Biology, Cambridge (England).
For primary bibliographic entry see Field 2D.
W87-08847

PHYSIOLOGICAL RESPONSES TO DROUGHT OF LOLIUM PERENNE L.: MEASUREMENT OF, AND GENETIC VARIATION IN, WATER POTENTIAL, SOLUTE POTENTIAL, ELASTICITY AND CELL HYDRATION,
Crop Genetics Group, Aberystwyth (Wales). Welsh Plant Breeding Station.
For primary bibliographic entry see Field 2D.
W87-08848

SPRING WHEAT GROWTH AT HIGH AND LOW SOIL WATER WITH CONSTRICTED UPPER ROOTS,
South Dakota State Univ., Brookings. Dept. of Plant Science.
For primary bibliographic entry see Field 2D.
W87-08893

ALGAL PHAGOTROPHY: REGULATING FACTORS AND IMPORTANCE RELATIVE TO PHOTOSYNTHESIS IN DINOBRYON (CHRYSOPHYCEAE),
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W87-08929

ECOLOGY OF A CRYPTOMONAS PHASEOLUS POPULATION FORMING A METALIMNETIC BLOOM IN LAKE CISO, SPAIN: ANNUAL DISTRIBUTION AND LOSS FACTORS,
Autonomous Univ. of Barcelona (Spain). Dept. of Microbiology.
For primary bibliographic entry see Field 2H.
W87-08930

SYNTHESIS OF A SIMPLIFIED WATER USE SIMULATION MODEL FOR PREDICTING WHEAT YIELDS,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soils.
V. K. Arora, S. S. Prihar, and P. R. Gajri.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 903-910, May 1987. 9 fig, 4 tab, 35 ref.

Descriptors: *Water conservation, *Plant water use, *Simulation, *Model studies, *Wheat, Evaporation, Drainage, Leaves, Roots, Crop yield, Soil water, Prediction, Water stress.

A simplified water use simulation model has been developed that predicts components of field water balance for wheat using information on atmospheric evaporative demand, extractable water and draining characteristics of soil profile, leaf area development, root growth characteristics, and soil wetting events. The model accounts for soil water flow with redistributing water below field capacity and estimates layerwise water use. Predicted evapotranspiration and soil water content in different soil layers matched well with the measured values for a wide range of water management situations and the root-mean-square error varied between 10 and 15%. Transpiration-yield relations, estimated through a multiplicative approach, showed that

booting-heading phase of wheat development was most sensitive to water stress. Validation of this model against independent data was reasonably well, thereby suggesting that the model dependably predicts grain yield. Small data required for the operation of the model increase its capability as management tool for efficient on-farm water use. (Author's abstract)
W87-09028

PERENNIAL PASTURE PRODUCTION AFTER IRRIGATION WITH SALINE GROUNDWATER IN THE GOULBURN VALLEY, VICTORIA,
Department of Agriculture and Rural Affairs, Victoria (Australia). Inst. for Irrigation and Salinity Research.
For primary bibliographic entry see Field 3C.
W87-09208

RESPONSES OF LEAF WATER POTENTIAL AND LEAF DIFFUSIVE RESISTANCE TO ABSCISIC ACID, WATER STRESS AND LOW TEMPERATURE IN HIBISCUS ESCULENTUS: THE EFFECT OF WATER STRESS AND ABA PRE-TREATMENTS,
University of the South Pacific, Suva (Fiji). Dept. of Biology.
For primary bibliographic entry see Field 2D.
W87-09210

COMPARATIVE STUDY ON THE INTRINSIC RATES OF INCREASE OF CYRTOBAGOUS SINGULARIS AND C. SALVINIAE ON THE WATER WEED SALVINIA MOLESTA,
Expand CSIRO, Indooroopilly (Australia). Long Pocket Labs.
For primary bibliographic entry see Field 4A.
W87-09217

HORMONAL REGULATION OF PROTEIN SYNTHESIS ASSOCIATED WITH SALT TOLERANCE IN PLANT CELLS,
Purdue Univ., Lafayette, IN. Dept. of Horticulture.
N. K. Singh, P. C. LaRosa, A. K. Handa, P. M. Hasegawa, and R. A. Bressan.
National Academy of Sciences (USA) Proceedings PNASAG, Vol. 84, No. 3, p 739-743, February 1987. 8 fig, 31 ref. DOE Grant DE13109.

Descriptors: *Plant physiology, *Proteins, *Salt tolerance, Tobacco, Sodium chloride, Adaptation, Cultures, Plant growth substances, Abscisic acid.

Cultured tobacco cells (Nicotiana tabacum cv. Wisconsin 38) synthesize a predominant 26-kDa protein upon exposure to abscisic acid (ABA). ABA also accelerates the rate of adaptation of unadapted cells to NaCl stress. The ABA-induced 26-kDa protein is immunologically cross-reactive to, and produces a similar pattern of peptides after partial proteolysis as, the major 26-kDa protein associated with NaCl adaptation. Both have pI values of >8.2. The synthesis of the ABA-induced 26-kDa protein is transient unless the cells are simultaneously exposed to NaCl stress. There is an association between increased intracellular accumulation of ABA during cell growth and commencement of the 26-kDa protein. ABA induces the synthesis of an immunologically cross-reactive 26-kDa protein in cultured cells of several plant species. In tobacco plants, synthesis of the 26-kDa protein could be detected in several tissues but the highest level of expression was seen in outer stem tissue. In root tissues, exogenous ABA greatly stimulated the synthesis of 26-kDa protein as compared to outer stem tissue and leaf. We suggest that ABA is involved in the normal induction of the synthesis of 26-kDa protein and that the presence of NaCl is necessary for the protein to accumulate. The protein may be conserved to perform a function related to NaCl adaptation. Furthermore, the highest level of synthesis of the protein occurs in outer stem tissue of tobacco, which contains the water- and solute-transporting vascular tissues. (Author's abstract)
W87-09227

EFFECTS OF CD(2+) AND EDTA ON YOUNG SUGAR BEETS (BETA VULUPTAKE AND DIS2R)B CA(2 OF MG(2+), CA(2+), AND FE(2+)/F+), AND FE(2+)/FE(3+),
Stockholm Univ. (Sweden). Dept. of Botany.
M. Greger, and S. Lindberg.
Physiologia Plantarum PHPLAI, Vol. 69, No. 1, p 81-86, January 1987. 4 fig, 2 tab, 20 ref.

Descriptors: *Bioaccumulation, *Nutrients, *Beets, *Plant growth, *Plant growth substances, *Plant physiology, *Heavy metals, *Cadmium, Magnesium, Calcium, Iron, Sludge.

Cadmium ions, which enter the soil with phosphate fertilizers, sewage sludge, and air pollutants, is taken up to various degrees by plants. The rate at which Cd(2+) is transported from roots to shoots differs among species, and the uptake, transport and subsequent distribution of other elements by the plant can be affected by the presence of cadmium ions. Levels of Mg(2+), Ca(2+) and Fe(2+)/Fe(3+) were determined in roots and shoots of sugar beets (Beta vulgaris cv. Monohill) cultured for 5 weeks in a complete nutrient solution to which either Cd(2+) (0, 5 or 50 microM), EDTA (0, 10, or 100 microM) or a combination of both was added. The plants subjected to the various treatments showed a variety of deficiency symptoms. Leaves of the Cd(2+)-treated plants became thin and chlorotic (Mg- and Fe-deficiency symptoms). The plants showed reduced growth and developed only a few brownish roots with short laterals (Ca-deficiency symptoms). EDTA treatment resulted in green, stunted, hard leaves and reduced growth (Ca-deficiency symptoms). The deficiency symptoms observed correspond well with the observed uptake rates and distributions of Mg(2+), Ca(2+), and Fe(2+)/Fe(3+). Increases in either Cd(2+), EDTA or a combination of both in the growth medium, were correlated with increasing Mg(2+) levels in the roots and with decreasing Mg(2+) levels in the shoots. Cd(2+) alone or in combination with EDTA had little influence on Ca(2+) levels in the shoots but decreased Ca(2+) levels in the roots. Thus, Cd(2+) affects Mg(2+) and Ca(2+) transport in opposite ways: Mg(2+) transport to the shoots is inhibited while that of Ca(2+) is facilitated. Treatment with EDTA alone did not affect Ca(2+) concentrations in either the shoots or the roots. Treatment with Cd(2+) lowered Fe(2+) concentrations in both roots and shoots. (Author's abstract)
W87-09228

INFLUENCE OF SIMULATED ACIDIC RAIN ON VEGETATIVE AND REPRODUCTIVE TISSUES OF CUCUMBER (CUCUMIS SATIVUS L.),
Boyce Thompson Inst. for Plant Research, Ithaca, NY.
For primary bibliographic entry see Field 5C.
W87-09232

MINERAL CONTENT OF GRASSES AND GRASSLANDS OF THE HIMALAYAN REGION: 2. CONCENTRATION OF TRACE AND MAJOR ELEMENTS IN GRASSES IN RELATION TO SOIL PROPERTIES AND CLIMATIC FACTORS,
Dept. of Soil Fertility and Management, Agricultural Univ. of Norway, 1432 As-NLH, Norway.
B. R. Singh, and V. K. Mishra.
Soil Science SOSCAK, Vol. 143, No. 4, p 241-256, April 1987. 2 fig, 11 tab, 41 ref.

Descriptors: *Grasses, *Minerals, *Nutrients, *Soil properties, Rainfall, Temperature, Himalaya, Climate, Heavy metals, Trace elements.

Grass samples, collected from different naturally occurring grasslands of the Himalayan region, were analyzed to determine concentrations of trace and major elements in the grasses. These concentrations were related to the concentrations of these elements in soils, soil chemical properties, and climatic factors. Means and ranges of the trace and major elements in the grasses are presented and discussed location wise and for the whole sampled area. There were manifold variations in the concentration of most of the trace elements in the grasses collected either from different sites at the same location or from different locations. Differences in the concentration of major elements were relatively small. A number of the grasses from humid or subhumid temperate zones were richer in the trace elements, viz., Zn, Cu, Fe, B, Mo, Ni, and Co, and in all major elements compared with those from the subhumid tropical or wet temperate zones. None of the grass samples analyzed was deficient in Zn, Cu, and Fe for normal plant growth, but about 2, 76, 2, 17-76, 21, 44, 6, and 73% of the grass samples may be considered deficient in Mn, B, Mo, N, P, K, Ca, and Mg, respectively. The percentage of the grass samples that may not meet the dietary requirements of sheep and cattle was 55 for Zn, 5 for Mn, 55 for Cu, 23 for Mo, 90 for I and Se, 15 for Co, 20-35 for N, 40 for P, 34 for K, 6 for Ca, 73 for Mg and 100 for Na. (Alexander-PTT)
W87-09256

WATER RELATIONS OF XERIC GRASSES IN THE FIELD: INTERACTIONS OF MYCORRHIZZAS AND COMPETITION,
Utah State Univ. Logan, Dept. of Range Science and Ecology Center.
E. B. Allen, and M. F. Allen.
New Phytologist NEPHAV Vol. 104, No. 4, p 559-571, December 1986. 5 fig, 2 tab, 33 ref. USDA Grants 83-CRCR-1-1229 and 83-CRCR-2-2274, and NSF Grant DEB 81-01827.

Descriptors: *Leaves, *Water potentials, *Agropyron, *Competition, *Nutrients, *Mycorrhiza, *Fungi, *Water relations.

The effect of vesicular-arbuscular mycorrhizal inoculm and competition from non mycorhizal annual plants were tested on agropyron smithii Rydb, and agropyron dasystachyum (Hook.) Scribn, growing in an inoculum poor soil. Mycorrhizal agropyron smithii decreased stomatal resistance (r sub s) and increased leaf water potential compared to the non inoculated plants but only during the driest portion of the growing season. The presence of annuals caused increased stomatal resistance of agropyron smithii, but only of non inoculated plants. Mycorrhizal plants had the same stomatal resistance with or without annuals, indicating that mycorrhizas may alleviate the detrimental effects of competition on stomatal resistance of agropyron smithii. By contrast, neither inoculation nor annuals significantly affected water relations of agropyron dasystachyum. Mycorrhizasal so did not increase nitrogen and phosphorus concentrations or percentage cover of either grass, but both had delayed phenology when mycorrhizal. This research was done during a wet year when the effects of mycorrhizas may be subtle. Long term observations are necessary to determine the importance of mycorrhizas under field conditions. (Author's abstract)
W87-09341

INTERACTION OF EUONYMUS SCALE (HOMOPTERA:DIASPIDIDAE) FEEDING DAMAGE AND SEVERE WATER STRESS ON LEAFF ABSCISSION AND GROWTH OF EUONYMUS FORTUNEI,
Kentucky Univ., Lexington. Dept. of Entomology.
S. D. Cockfield, and D. A. Potter.
Oecologia OECOBX, Vol. 71, No. 1, p 41-46. December 1986. 6 fig, 29 ref.

Descriptors: *Disipidae, *Water stress, *Scale, *Abscission, *Drought effects, *Plant diseases, Roots, Growth, Plants.

Rooted cuttings of Euonymus fortunei were grown in a 2 x 2 factorial design experiment with or without euonymus scales and/or water stress. Infested plants and water stressed plants abscised leaves whereas uninfested unstressed plants did not. There was no significant interaction between scale interactions and water stress, with a synergistic effect on leaf abscission. Both scale infestation and water stress reduced the root weight, but there was no resulting change in the root/shoot ratio. Naturally infested leaves on plants growing outdoors had a higher solute potential and a lower pressure potential than did uninfested leaves with

the same water potential. Infested leaves may therefore be more prone to wilting. However, scale damaged leaved also have increased diffusive resistance and lowered transpiration rates, suggesting that scales impair normal function of guard cells. The possible contribution of these factors to the heightened susceptability of infested leaves to abscission following water stress is discussed. (Author's abstract)
W87-09344

WATER VAPOR UPTAKE AND PHOTOSYNTHESIS OF LICHENS: PERFORMANCE DIFFERENCES IN SPECIES WITH GREEN AND BLUE-GREEN ALGAE AS PHYCOBIONTS,
Wurzburg Univ. (Germany, F.R.). Lehrstuhl fur Botanik II.
O. L. Lange, E. Kilian, and H. Ziegler.
Oecologia OECOBX, Vol. 71, No. 1, p 104-110, December 1986. 8 fig, 23 ref.

Descriptors: *Lichens, *Water vapor uptake, *Photosynthesis, *Water relations, *Respiration, Algae, Phycobionts.

Dry lichen thalli were enclosed in gas exchange chambers and treated with an air stream of high relative humidity (96.5 to near 100 percent) until water potential equilibrium was reached with the surrounding air. They were then sprayed with liquid water. The treatment took place in the dark and was interrupted by short periods of light. CO2 exchange during light and dark respiration was monitored continuously. Water uptake in all of the lichen species with green algae as the phycobiants lead to reactivation of the photosynthetic metabolism. Furthermore, high rates of CO2 assimilation were attained without the application of liquid water. In contrast, hydration through high air humidity alone failed to stimulate positive net photosynthesis in any of the lichens with blue-green algae. These required liquid water for CO2 assimilation. Carbon isotope ratios of the lichen thalli suggest that a definite ecological difference exists in water status dependent photosynthesis of species with green or blue phycobiants. The underlying biochemical or biophysical mechanisms are not yet understood. Apparently, a fundamental difference in the structure of the two groups of algae is involved. (Author's abstract)
W87-09345

RESPONSES OF GAS EXCHANGE TO HUMIDITY IN POPULATIONS OF THREE HERBS FROM ENVIRONMENTS DIFFERING IN ATMOSPHERIC WATER,
Agricultural Research Service, Beltsville, MD. Plant Photobiology Lab.
J. A. Bunce.
Oecologia OECOBX, Vol. 71, No. 1, p 117-120. December 1986. 3 tab, 18 ref.

Descriptors: *Leaves, *Gas exchange, *Humidity, *Photosynthesis, *Stomatal conductance, *Vapor pressure, *Morphology, Plants, Herbs, Roots.

Responses to humidity of net photosynthesis and leaf conductance of single attached leaves were examined in populations of herbs in Beltsville, Maryland and Davis, California, USA. Plants were grown in controlled environments under three conditions which differed in magnitude of the day/night temperature difference and in daytime air saturation deficit. No population differences in responses were found in Abutilon theophrasti. In Amaranthus hybridus stomatal conductance and net photosynthesis were more reduced by increasing leaf to air water vapor pressure difference (VPD) in the population from Beltsville, but only for the growth conditions with a constant 25C temperature. In Chenopodium album, stomatal conductance was more sensitive to VPD in the population from Davis, but only for the growth condition with 28/22C day/night temperatures. Population differences in the sensitivity to VPD of leaf conductance were associated with the leaf are to root weight ratio. The relative reduction of net photosynthesis as net VPD increased was greater than, equal to, or less than the relative decrease in substomal carbon dioxide partial pressure. The pattern depended on species and on growth conditions. From these results one cannot conclude that environmental humidity has been a strong selective force in determining sensitivity to humidity of stomatal conductance. (Author's abstract)
W87-09346

EFFECTS OF WATER STRESS ON GAS EXCHANGE AND WATER RELATIONS OF SUCCULENT EPIPHYTE, KALANCHOE UNIFLORA,
Technische Hochschule Darmstadt (Germany, F.R.). Institut fur Botanik.
C. Schafer, and U. Luttge.
Oecologia OECOBX, Vol. 71, No. 1, p 127-132. December 1986. 6 fig, 1 tab, 30 ref.

Descriptors: *Gas exchange, *Epiphytes, *Kalochoe, *Water stress, *Water relations, *Respiration, Plant physiology, Growth.

Measurements of gas exchange, exylem tension and nocturnal malate synthesis were conducted with well watered and droughted plants of Kalanchoe uniflora. Corresponding results were obtained with plants grown in 9 h and 12 h photoperiods. In well watered plants 50 to 90 percent of the total C02 uptake occurred during the light period. Nocturnal C02 uptake and malate synthesis were higher and respiration rate was lower in old leaves compared to young leaves. Within 4 days of drought distinct physiological changes had occurred. Gas exchange during the light period decreased and C02 uptake during the dark period increased. Nocturnal malate synthesis significantly increased in young leaves. Respiration rate decreased during periods of drought, this decrease being more pronounced in young leaves compared to old leaves. Restriction of gas exchange during the light period resulted in a decrease of transpiration ratio from more than 100 to about 20. The difference between osmotic pressure and xylem tension decreased in young leaves, indicating a reduction in bulk leaf turgorpressure. We conclude that both the CAM enhancement in young leaves and the decrease of respiration rate are responsible for the increase in nocturnal C02 uptake during water stress. During short periods, which frequently occur in humid habitats, the observed physiological changes maintained. This might be relevent for plant growth in the natural habitat. (Author's abstract)
W87-09347

COMPARATIVE STUDIES OF PLANT GROWTH AND DISTRIBUTION IN RELATION TO WATERLOGGING: XI. GROWTH OF GEUM RIVALE L. AND GEUM URBANUM L. AND SOIL CHEMICAL CONDITION IN EXPERIMENTALLY FLOODED SOIL,
Dept. of Plant Science, Univ. College Cardiff, PO Box 78, Cardiff CF1 1XL, UK.
S. Waldren, M. S. Davies, and J. R. Etherington.
New Phytologyst NEPHAV, Vol. 105, No. 4, p 551-562, April 1987. 5 fig, 2 tab, 41 ref.

Descriptors: *Waterlogging, *Plant growth, *Plant water relations, *Flooding, *Comparison studies, *Geum, Compost, Nutrients, Roots, Biomass, Distribution.

The tolerance of Geum rivale L. and G. urbanum L. to soil waterlogging was investigated by growing plants in a compost under a variety of flooding regimes. Chemical analyses showed that high concentrations of available ammonium, iron and manganese but almost no nitrate could be extracted from this compost if conditions became sufficiently reducing, though a considerable period of flooding was required for such reducing conditions to develop. This slow rate of reduction may be due to the absence of an anaerobic microflora in the loam base of the compost. Waterlogging caused a reduction in root biomass and a change in the distribution of living roots fo both species such that rooting was restricted to the surface zones of flooded soil. G. rivale possessed a rhizome-like caudex, which is virtually absent in G. urbanum, and it is suggested that this may facilitate adventitious rooting which aids survival in waterlogged soil. The numbers of leaves, shoot apices and leaves per apex were reduced by flooding in G. urbanum but not in G. rivale. The responses of the two species to transient flooding, soil volume and soils with and without a previous flooding history are discussed in relation to their distribution. (See also W87-09399 and W87-09400) (Author's abstract)
W87-09398

COMPARATIVE STUDIES OF PLANT GROWTH AND DISTRIBUTION IN RELATION TO WATERLOGGING: XII. GROWTH, PHOTOSYNTHETIC CAPACITY AND METAL ION UPTAKE IN SALIX CAPREA AND S. CINEREA SSP. OLEIFOLIA,
Dept. of Plant Science, Univ. College Cardiff, PO Box 78, Cardiff CF1 1XL, UK.
R. J. Talbot, J. R. Etherington, and J. A. Bryant.
New Phytologyst NEPHAV, Vol. 105, No. 4, p 563-574, April 1987. 4 fig, 3 tab, 40 ref.

Descriptors: *Waterlogging, *Plant growth, *Plant water relations, *Flooding, *Comparison studies, *Salix, Leaves, Biomass, Nutrients, Iron, Roots.

Rooted cuttings of Salix caprea L. and S. cinerea ssp. oleifolia (Macreight) growing in soil were exposed to (a) intermittent, (b) partial and (c) complete waterlogging of the soil. Measurements of growth and other characteristics were compared with unflooded controls. Both species were harmed by waterlogging but S. caprea was more sensitive than S. cinerea as shown by the greater reduction of height, internode number, dry weight of root, stem and leaf, specific leaf area and leaf area per plant. The waterlogging treatments did not differ amongst themselves in the degree of inhibition of growth which they caused. A single fully waterlogged treatment would thus have been quite adequate in screening for tolerance. The reduction in specific leaf area of S. caprea was probably mediated by reduced turgidity and failure of leaf tissue to expand fully. Leaf iron content increased in both species but less so in S. cinerea, which is able to immobilize more iron in, or on, its roots. S. caprea leaves contained over 2000 microgram(ug)/g iron, a concentration recorded as toxic in other plants; these leaves became brittle and some lower leaves were shed. Root iron content increased more in S. cinerea. Photosynthetic potential was reduced in S. caprea but not in S. cinerea; this was probably unrelated to stomatal control of CO2 uptake. S. cinerea produced adventitious roots at the surface of flooded soil and when cuttings were immersed in water; S. caprea did not. These observations are compatible with the ecology of the two species, S. caprea normally inhabiting better drained soils than S. cinerea. (See also W87-09398 and W87-09400) (Author's abstract)
W87-09399

COMPARATIVE STUDIES OF PLANT GROWTH AND DISTRIBUTION IN RELATION TO WATERLOGGING: XIII. THE EFFECT OF FE(2+) ON PHOTOSYNTHESIS AND RESPIRATION OF SALIX CAPREA AND S. CINEREA SSP. OLEIFOLIA,
Dept. of Plant Science, Univ. College Cardiff, PO Box 78, Cardiff CF1 1XL, UK.
R. J. Talbot, and J. R. Etherington.
New Phytologyst NEPHAV, Vol. 105, No. 4, p 575-583, April 1987. 3 fig, 22 ref.

Descriptors: *Waterlogging, *Plant growth, *Plant water relations, *Flooding, *Comparison studies, *Salix, *Nutrients, *Iron, Sulfates, Photosynthesis, Roots.

Rooted cuttings of Salix caprea and of S. cinerea ssp. oleifolia were supplied with 0 to 320 mg Fe(2+)/cu dm as sulfate dissolved in nutrient solution either at a constant concentration or supplied incrementally. Photosynthesis and respiration of the treated plants was monitored by infrared gas analysis for periods of 4 to 7 d. Control shoots, in air-bubbled or nitrogen-bubbled solutions, maintained constant rates of photosynthesis and dark respiration during the experimental period. S. cinerea was unaffected by a constant concentration of 160 mg Fe(2+)/cu dm or incremental additions reaching 320 mg Fe(2+)/cu dm. S. caprea was unaffected by 10 mg Fe(2+)/cu dm, but a constant concentration of 40 mg Fe(2+)/cu dm or incre-

mental additions reaching 40 mg Fe(2+)/cu dm caused almost total inhibition of photosynthesis and considerable reduction of respiration. Repeating these experiments using cuttings with excised roots increased the sensitivity of both species so that, even in S. cinerea, 10 mg Fe(2+)/cu dm was inhibitory to photosynthesis. (See also W87-09398 and W87-09399) (Author's abstract)
W87-09400

EFFECT OF WATERLOGGING ON INFECTION OF EUCALYPTUS MARGINATA SEEDLINGS BY PHYTOPHTHORA CINNAMOMI,
Dept. of Conservation and Environment, 1 Mount Street, Perth, Western Australia 6000.
E. M. Davison, and F. C. S. Tay.
New Phytologyst NEPHAV, Vol. 105, No. 4, p 585-594, April 1987. 3 fig, 1 tab, 32 ref.

Descriptors: *Waterlogging, *Plant growth, *Plant water relations, *Flooding, *Comparison studies, *Eucalyptus, *Plant diseases, Roots, Zoospores, Lesions, Phytophthora.

Three- to four-month-old Eucalyptus marginata Donn ex Sm. (jarrah) were grown in the glasshouse in peat/sand at 20 C root temperature, infected with zoospores of Phytophthora cinnamomi Rands, added either 10 cm below the soil surface or flooded onto the soil, and various waterlogging regimes were imposed. When plants were infected but not waterlogged, the proportion of infected root length adjacent to the point where zoospores were added was low. More lesions were formed per meter root length on tap roots than on lateral roots, but lesions on lateral roots were longer than on tap roots. When plants were waterlogged for a 4 d period before the addition of zoospores, there was no increase in root infection. When plants were waterlogged at the same time or after the pots were inoculated, there was a significant increase in the proportion of root length infected. This was due to an increase in the number of lesions and not, in four of the five harvests, to an increase in lesion. When inoculation and waterlogging were imposed at the same time, the increased number of infections was probably due both to the increased attraction of zoospores to anaerobically respiring roots and to increased zoospore motility in flooded soil. When waterlogging was imposed several days or weeks after the plants had been infected, the increased number of lesions was unlikely to have been due to residual zoospores in the soil, because their numbers declined exponentially. It was also unlikely to have been due to sporangia developing de novo on the roots after waterlogging had been imposed, because the O2 concentration of the soil solution was inadequate. It is probable, therefore, that the new infections originated from zoospores liberated from sporangia already formed on lesions before waterlogging was imposed. When plants were infected but not waterlogged, there was no effect on the leaf diffusive resistance, leaf relative water content and shoot xylem pressure potential between 1 and 28 d. When plants were flooded, the daily water loss decreased more rapidly and plants died more rapidly in the inoculated and waterlogged treatments than in the treatments which were only waterlogged. Infection by P. cinnamomi did not affect the proportion of xylem vessels occluded with tyloses in seven of the eight unflooded, and seven of the eight flooded, comparisons. (Author's abstract)
W87-09401

IMPACT OF IRRIGATION AND EXPERIMENTAL DROUGHT STRESS ON LEAF-MINING INSECTS OF EMORY OAK,
Arizona State Univ., Tempe. Dept. of Zoology.
T. L. Bultman, and S. H. Faeth.
Oikos OIKSAA, Vol. 48, No. 1, p 5-10, January 1987. 4 fig, 2 tab, 31 ref. NSF Grants BSR-8118032 and BSR-8415616.

Descriptors: *Water stress, *Drought effects, *Irrigation, *Herbivory, *Oak trees, *Insects, Roots, Leaf miners, Leavers, Cameraria, Parasites.

The hypothesis that drought-stressed trees suffer higher levels of herbivory than unstressed trees was tested experimentally with two as yet undescribed species of Cameraria leaf miners. Densities and site selection of the species differ within a common host plant. Several roots of four trees in a wash were severed and four trees at a more xeric site were irrigated. Densities of leaf miners on the experimental trees and also on four control trees were monitored at each of the two sites. Both irrigation and root cutting affected foliar water content as expected. In apparent contrast to predictions of the 'stress hypothesis', leaf miners occurred more frequently on irrigated trees than controls at the xeric site and were more abundant on control trees than those with cut roots at the wash. Survival of Cameraria at the wash did not differ between experimental and control trees. Stressed trees may have been severely, rather than moderately stressed and this may explain why miners preferred unstressed trees. Mortality due to parasitoids and predators appears much higher for miners at the drier site compared with those at the wash and may explain observed differences in densities of the leaf-mining insects. (Author's abstract)
W87-09402

EFFECTS OF SIMULATED ACIDIC MIST ON GERMINATION OF ALTERNARIA SOLANI AND PHYTOPHTHORA INFESTANS IN VITRO AND THEIR INFECTION EFFICIENCY AND SPORULATION ON POTATO,
Boyce Thompson Inst. for Plant Research, Ithaca, NY.
For primary bibliographic entry see Field 5C.
W87-09414

CHANGES AT PANICLE EMERGENCE IN THE WATER RELATIONS OF A WETLAND AND A DRYLAND JAPONICA RICE CULTIVAR UNDER WETLAND CONDITIONS,
Hokuriku National Agricultural Experiment Station, Inada, Joetsu-shi, Niigata-ken, 943-01, Japan.
S. Takami, S. Ahmad, N. C. Turner, T. Kobata, and J. C. O'Toole.
Physiologia Plantarum PHPLAI, Vol. 69, No. 4, p 586-590, April 1987. 5 fig, 12 ref.

Descriptors: *Plant water relations, *Japonica, *Rice, *Wetlands, *Flooding, *Leaves, *Water potentials, Seasonal variation, Plants, Food crops, Turgor, Panicles, Growth.

The diurnal and seasonal changes in plant water relations of two Japonica rice (Oryza sativa L.) cultivars, Nipponbare and Tachiminori, were studied under flooded conditions at Kyoto University. The dryland cv. Tachiminori maintained higher predawn and midday leaf osmotic potentials relative to the wetland cv. Nipponbare during the vegetative stage, but the ranking was reversed after flowering. The relationship between leaf water potential and leaf osmotic potential showed that prior to panicle emergence Nipponbare was able to adjust osmotically to maintain turgor, whereas after heading there was little turgor maintenance. Tachiminori showed little difference in osmotic adjustment before and after panicle emergence. Fertilizer treatment during panicle development also helped to maintain the degree of osmotic adjustment in both cultivars. (Author's abstract)
W87-09415

YIELD REDUCTIONS IN WINTER BARLEY GROWN ON A RANGE OF SOILS AND EXPOSED TO SIMULATED ACID RAIN,
Inst. of Terrestrial Ecology, Bangor Research Station, Penrhos Road, Bangor Gwynedd LL57 2LQ, North Wales, UK.
For primary bibliographic entry see Field 5C.
W87-09416

GLUTATHIONE STATUS AND PROTEIN SYNTHESIS DURING DROUGHT AND SUBSEQUENT REHYDRATION IN TORTULA RURALIS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
R. S. Dhindsa.
Plant Physiology PLPHAY, Vol. 83, No. 4, p 816-819, April 1987. 5 fig, 20 ref.

Descriptors: *Tortula, *Mosses, *Glutathione, *Drought effects, *Water stress, *Proteins, Rehydration, Amino acids, Plant physiology, Inhibition.

Glutathione status and its relationship to protein synthesis during water deficit and subsequent rehydration have been examined in the drought-tolerant moss, Tortula ruralis. During slow drying there is a small decrease in total glutathione but the percentage of oxidized glutathione (GSSG) increases. During rapid drying there is little change in total glutathione but a small increase in GSSG. On rehydration of slowly dried moss, GSSG rapidly declines to normal level. But when rapidly dried moss is rehydrated, there is an immediate, sharp increase in GSSG as a percentage of total glutathione. After 2 hours of rehydration GSSG starts declining and reaches a normal level in about 6 hours. When an increasing degree of steady state water deficit is imposed on the moss tissue with polyethylene glycol 6000, there is a progressive decrease protein synthesis but an increase in oxidized glutathione. When 5 millimolar GSSG is supplied exogenously during rehydration of rapidly dried or slowly dried moss, protein synthesis is strongly inhibited. In vitro protein synthesis supported by moss mRNA is also inhibited by more than 85% by 150 micromolar GSSG. The role of glutathione status in water deficit-induced inhibition of protein synthesis is discussed. (Author's abstract)
W87-09417

INDUCTION OF CRASSULACEAN ACID METABOLISM IN MESEMBRYANTHEMUM CRYSTALLINUM BY HIGH SALINITY: MASS INCREASE AND DE NOVO SYNTHESIS OF PEP-CARBOXYLASE,
Botanisches Institut der Universitat Wurzburg, Mittlerer Dallenbergweg, D 8700 Wurzburg, Federal Republic of Germany.
For primary bibliographic entry see Field 3C.
W87-09418

LEAF PHOTOSYNTHESIS AND CONDUCTANCE OF SELECTED TRITICUM SPECIES AT DIFFERENT WATER POTENTIALS,
Oklahoma State Univ., Stillwater. Dept. of Agronomy.
R. C. Johnson, D. W. Mornhinweg, D. M. Ferris, and J. J. Heitholt.
Plant Physiology PLPHAY, Vol. 83, No. 4, p 1014-1017, April 1987. 4 fig, 1 tab, 14 ref.

Descriptors: *Photosynthesis, *Wheat, *Water potentials, *Gas exchange, *Water stress, *Plant water use, Conductance, Food crops, Plants.

Leaf gas exchange characteristics of a desert annual (Triticum kotschyi (Boiss.)Bowden) and the wheat cultivar TAM W-101 (Triticum aestivum L. em Thell) were compared over a range of leaf water potentials from -0.50 to -2.9 megapascals. At an ambient (CO2) of 330 microliters per liter, T. kotschyi had higher conductance and CO2 assimilation (A) at a given water potential than T. aestivum. Under well watered conditions, A versus internal CO2 concentration (C sub i) response curves for both species were similar in shape and magnitude, and the higher A of T. kotschyi at an ambient (CO2) of 330 microliters per liter was mostly related to the higher stomatal conductance of T. kotschyi. The higher conductance of T. kotschyi than T. aestivum under well watered conditions was associated with higher C sub i and lower water use efficiency. Under water deficits, however, C sub i at 330 microliters per liter ambient (CO2) did not differ significantly between species. T. kotschyi had higher A under water deficits than T. aestivum primarily because its A versus C sub i response curves had higher A at C sub i values above about 150 microliters per liter. The results show that conductance played an important role in the high A of T. kotschyi under well watered conditions, but under water deficits the high A of T. kotschyi was related more to the maintenance of a higher capacity for mesophyll photosynthesis. (Author's abstract)
W87-09419

ADVANCES IN IRRIGATION, VOLUME 3.

Massachusetts Univ., Amherst. Dept. of Plant and Soil Sciences.
For primary bibliographic entry see Field 3F.
W87-09464

2J. Erosion and Sedimentation

SEMIARID SOIL AND WATER CONSERVATION,
Finkel and Finkel, Yoqneam (Israel).
For primary bibliographic entry see Field 3F.
W87-08661

SOIL EROSION PROCESS,
Finkel and Finkel, Yoqneam (Israel).
H. J. Finkel.
IN: Semiarid Soil and Water Conservation, CRC Press, Inc., Boca Raton, FL. 1986. p 27-37, 3 fig, 3 tab, 12 ref.

Descriptors: *Soil erosion, *Semiarid lands, *Universal Soil Loss Equation, *Erosion, Wind erosion, Soil loss, Rainfall-runoff relationships, Rill erosion, Gully erosion, Channel erosion, Mathematical studies.

Soil erosion may be defined as the detachment and removal of soil material from the surface of the ground, either by water or by wind. Over the past 40 years in the U.S., there have been many experimental studies relating soil erosion to various parameters of soil, topography, cover, rainfall, etc. The mass of data thus collected has been summarized in a monumental study, and generalized into the now-celebrated Universal Soil Loss Equation (USLE). It is A = R K L S C P, where A is the estimated soil loss in tons per acre per year; R is the rainfall and runoff factor expressed as the number of rainfall erosion units, corrected where necessary for snowmelt and/or irrigation; K is the soil erodibility factor, expressed as the soil loss per erosion index unit for a standard slope of 9% over a length of 72.6 ft; L is the slope length factor which is the ratio of soil loss from the field in question to that on the standard slope under identical conditions; S is the slope steepness factor which is the ratio of soil loss from the field in question to that of the standard slope under identical conditions; C is the cover and management factor which is the ratio of the soil loss under a specific management and cover to that of an area in continuous tilled fallow under otherwise identical conditions; and P is the supporting practice factor which is the ratio of soil low under a given support practice with that of farming straight up and down the slope. Water erosion may take several forms such as drop splash, surface flow erosion (sometimes called sheet erosion), rill, gully, stream bank, and channel erosion. Each of these has been amply described in the technical literature, but is considered here with special reference to semiarid conditions. (See also W87-08661) (Lantz-PTT)
W87-08663

AGRONOMIC MEASURES FOR SOIL AND WATER CONSERVATION,
Finkel and Finkel, Yoqneam (Israel).
For primary bibliographic entry see Field 3F.
W87-08664

GULLEY CONTROL,
Finkel and Finkel, Yoqneam (Israel).
For primary bibliographic entry see Field 3F.
W87-08669

FLUVIAL HYDROLOGY,
New Hampshire Univ., Durham.
For primary bibliographic entry see Field 2A.
W87-08685

EROSION AND SEDIMENT CONTROL HANDBOOK,
California Tahoe Conservancy.
For primary bibliographic entry see Field 4D.
W87-08686

EFFECT OF SOIL SLIP EROSION ON WAIROA HILL PASTURE PRODUCTION AND COMPOSITION,
Aokautere Ministry of Works and Development, Palmerston North (New Zealand). Soil Conservation Centre.
G. B. Douglas, N. A. Trustrum, and I. C. Brown.
New Zealand Journal of Agricultural Research NEZFA7, Vol. 29, No. 2, p 183-192, 1986. 4 fig, 3 tab, 33 ref.

Descriptors: *Soil erosion, *Erosion, *Slope degradation, *Pastures, *Slip erosion, *Pastures, *Productivity, Biomass, Nutrients, New Zealand, Yield, Plants, Model studies.

Dry matter production, botanical composition, soil fertility parameters, and foliar nutrient concentrations were measured on hillslope pastures in Wairoa in the North Island of New Zealand, for up to 3 years starting in 1982. Measurement sites were on 10 physiographically different landform units (pre-1942, 1942, 1970, and 1977 slip scars, 1970 and 1977 accumulation zones, footslope ridges, spurs, flats, and lower pumice ridges) representing the erosion-sedimentation continuum of the area. Average annual pasture production on pre-1942 scars was 7.5 t dry matter/ha. Similar yields were recorded from 1942 and 1970 scars, but the 1977 scars produced only 2.6 t dry matter/ha. A model derived from analysis of these results indicated that pasture recovery was exponential, recovery was most rapid in the first 10 years after slipping, and after 30 years there was no further increase in production. The proportions of the grass and clover pasture components increased and decreased, respectively, with increasing length of time since slipping. Soil pH and calcium levels generally declined with scar age and were lowest for spurs, but the reverse trend was generally true for potassium, phosphate retention, and sulfur. Moisture content and phosphate retention were higher on treads than scarps. All other landform units produced more dry matter annually than any slip scar. The results show the necessity of studying landform units separately in any research on hill country pastoral productivity, and confirm many of the findings from previous work in the Wairarapa, particularly those relating to the rate of pasture recovery. (Author's abstract)
W87-08734

ANALYSIS OF HORIZONTALLY TWO-DIMENSIONAL MORPHOLOGICAL EVOLUTIONS IN SHALLOW WATER,
Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 7C.
W87-08782

COUNTING THE DAYS ALONG LAKE MICHIGAN,
M. Krance.
Oceans, Vol. 20, No. 2, p 6, 7, 62, April 1987.

Descriptors: *Erosion, *Flood damage, *Flooding, *Lake Michigan, *Lakes, *FLood control, *Shore protection, Floods, Beach erosion, Erosion rates, Lake shores, Protection, Shores, Water level, Breakwaters, Waves, Michigan, Indiana, Levees, Great Lakes.

Shoreline homes and lakefront property in Michigan and Indiana have been destroyed by recurring flooding caused by storms and rising water levels in Lake Michigan. Data on the levels of Lake Michigan that go back 125 years show that the lake hit record high levels in 1986 and geological calculations indicate that those high levels are really only average. The Army Corps of Engineers is authorized to provide emergency assistance for flooding and has built offshore segmented breakwaters and sloped revetments to decrease wave size in critical areas on Chicago's north side. Indiana shore residents, who do not qualify for such help because they are private owners suffering from erosion problems, have built temporary levees. There is a lack of large-scale shoreline management studies and programs since under the Reagan administration, shoreline protection is regarded as a state and local responsibility. Similar problems on the shores of the other Great Lakes were also cited. (Wood-PTT)
W87-08804

RIVER FLOW WITH EXCESSIVE SUSPENDED SEDIMENT LOAD: AN EVALUATION OF TURBULENT FLOW CHARACTERISTICS,
Lulea Univ. of Technology (Sweden).
For primary bibliographic entry see Field 2E.
W87-08826

SHIFTING OF THE KOSI RIVER, NORTHERN INDIA,
Kent State Univ., OH. Dept. of Geology.
For primary bibliographic entry see Field 2E.
W87-08834

HYDRODYNAMICS AND STRUCTURE: INTERACTIVE EFFECTS ON MEIOFAUNA DISPERSAL,
Wabash Coll., Crawfordsville, IN. Dept. of Biology.
For primary bibliographic entry see Field 2L.
W87-08838

CARBON ISOTOPE FRACTIONATION AND CHANGES IN THE FLUX AND COMPOSITION OF PARTICULATE MATTER RESULTING FROM BIOLOGICAL ACTIVITY DURING A SEDIMENT TRAP EXPERIMENT IN LAKE GREIFEN, SWITZERLAND,
Woods Hole Oceanographic Institution, MA.
For primary bibliographic entry see Field 2H.
W87-08867

VERTICAL TRANSPORT OF HEAVY METALS BY SETTLING PARTICLES IN LAKE ZURICH,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5B.
W87-08869

TRANSPORT OF SOLIDS IN STREAMFLOW FROM COASTAL PLAIN WATERSHEDS,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
J. M. Sheridan, and R. K. Hubbard.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 2, p 131-136, April-June 1987. 6 fig, 4 tab, 35 ref.

Descriptors: *Suspended load, *Streamflow, *Runoff, *Coastal plains, *Watersheds, *Sediment transport, *Drainage, Flow, Suspended solids, Hydrology, Transport, Agriculture, Seasonal variation.

Concentrations and loads of solids transported in runoff from seven southeastern Coastal Plain watersheds with low-gradient drainage systems were related to hydrologic patterns. Total solids (TS) concentrations in streamflow averaged 96 + or - 81 mg/L. Concentrations were significantly lower during the December through May high runoff period. Higher TS concentrations (> 250 mg/L) primarily occurred following prolonged no-flow periods, which typically occur in the late summer and fall. Monthly TS loads (avg, 26.7 kg/ha) were largely a function of monthly runoff volume. Suspended sediment (SS) concentrations in streamflow averaged 15 + or - 20 mg/L. Suspended sediment concentrations were significantly higher from March through August, when agricultural activity was greatest. Monthly SS loads (avg, 4.60 kg./ha) were also largely a function of monthly runoff volume. The dissolved component is the predominant portion of TS transported in runoff from Coastal Plain watersheds. The low sediment loads are attributed to deposition occurring within the low-gradient, heavily vegetated drainage systems. (Author's abstract)
W87-08924

RESUSPENSION IN THE SHALLOW SUBLITTORAL ZONE OF A MACROTIDAL ESTUARINE ENVIRONMENT: WIND INFLUENCE,
Ministere des Peches et des Oceans (Quebec). Inst.

Maurice-Lamontagne.
For primary bibliographic entry see Field 2L.
W87-08933

SEDIMENTATION IN LAKE ONALASKA, NAVIGATION POOL 7, UPPER MISSISSIPPI RIVER, SINCE IMPOUNDMENT,
U.S. Fish and Wildlife Service, La Crosse, WI. Northern Prairie Wildlife Research Center.
C. E. Korschgen, G. A. Jackson, L. F. Muessig, and D. C. Southworth.
Water Resources Bulletin WARBAQ, Vol. 23, No. 2, p 221-226, April 1987. 6 fig, 17 ref.

Descriptors: *Sedimentation, *Lake Onalaska, *Limnology, *Reservoirs, *Computer programs, *Mississippi River, Water depth, Surveys, Sediment cores, Cesium isotopes.

Sediment accumulation was evaluated in Lake Onalaska, a 2800-ha backwater impoundment on the Upper Mississippi River. Computer programs were used to process fathometric charts and generate an extensive data set on water depth for the lake. Comparison of 1983 survey data with pre-impoundment (before 1937) data showed that Lake Onalaska had lost less than 10 percent of its original mean depth in the 46 years since impoundment. Previous estimates of sedimentation rates based on Cesium-137 sediment core analysis appear to have been too high. (Author's abstract)
W87-08969

DOWNWARD MOVEMENT OF PARTLY DEGRADED MATERIALS IN DYKED MARSH SOILS,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Centre.
For primary bibliographic entry see Field 2H.
W87-08998

CAROLINA BAYS ON THE EASTERN SHORE OF MARYLAND: I. SOIL CHARACTERIZATION AND CLASSIFICATION,
Maryland Univ., College Park. Dept. of Agronomy.
For primary bibliographic entry see Field 2H.
W87-08999

SLOPE GRADIENT EFFECT ON EROSION OF RESHAPED SPOIL,
North Dakota State Univ., Mandan. Land Reclamation Research Center.
S. A. Schroeder.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 405-409, March-April 1987. 2 fig, 4 tab, 18 ref.

Descriptors: *Sediments, *Mathematical equations, *Erosion, *Mine wastes, *Slope gradient, Infiltration, Density, Rainfall, Prediction, Field tests.

Eroded sediment from reshaped spoil areas of surface mines with steep slope gradients may damage the productivity of surrounding reclaimed and undisturbed areas. Spoil erosion is made more severe by low infiltration rates caused by high bulk densities and, thus, low porosities. The objective of this research was to determine the applicability of the Universal Soil Loss Equation (USLE) slope function for predicting spoil erosion rates. The effect of slope gradient on sediment losses from reshaped spoil at two surface mines was quantified by using a rainfall simulator. Slopes ranged from 0.1 to 11.1%. Three sites, differing in sodium adsorption ratio (SAR), were selected. Spoil surface conditions were either crusted (CR) or tilled by hand to simulate freshly respread (FR). Spoil losses (data combined over sites) were significantly greater initially dry CR than FR surfaces but significantly less for wet and very wet surface conditions. Spoil loss increased linearly with increasing slope gradient at all sites for both surface conditions (CR and FR). The rainfall sequence at the low SAR site for the FR surface (two 1-h runs) contributed to the significant difference found for that site's slope gradient effect on spoil loss when compared to the other two sites (one 1-h and two 30-min application sequences). The latter two sites' slope gradient effects on spoil loss were not significantly different from one another. No differences in the slope gradient equations were found between the three sites for the CR surface condition. The USLE curvilinear soil loss ratio (SLR) function underestimated the slope gradient effect on spoil loss for slopes $< 9\%$ and overestimated at slopes $> 9\%$ compared to the developed spoil SLR function. Regression/correlation analyses showed a highly significant linear relationship between spoil K values predicted using the FR field data and the developed spoil SLR function to the K values estimated using the USLE nomograph. The K values from the field were approximately 81% of the nomograph. Use of the spoil SLR function and prediction model for K should allow adequate estimation of spoil erosion losses. (Author's abstract)
W87-09000

RIPARIAN AREAS AS FILTERS FOR AGRICULTURAL SEDIMENT,
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
For primary bibliographic entry see Field 4A.
W87-09002

CONTROL OF FURROW EROSION WITH CROP RESIDUES AND SURGE FLOW IRRIGATION,
Agricultural Research Service, Prosser, WA.
For primary bibliographic entry see Field 3F.
W87-09003

RELATIONSHIPS BETWEEN WATERDROP PROPERTIES AND FORCES OF IMPACT,
Purdue Univ., Lafayette, IN. Agricultural Experiment Station.
M. A. Nearing, and J. M. Bradford.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 425-430, March-April 1987. 11 fig, 3 tab, 21 ref.

Descriptors: *Soil erosion, *Rainfall impact, *Waterdrop impact, *Erosion, Kinetics, Momentum, Velocity.

Waterdrop impact forces cause detachment of particles from soil surfaces and are an important component of soil erosion. This study was undertaken to determine the effects of waterdrop properties on waterdrop impact forces. Forces of impact were measured with a piezoelectric transducer for 3.31-, 3.83-, and 4.51-mm-diam drops falling from heights of 0.5, 1.4, 3.3, 6.4, and 14.0 m. Mean peak force of impact was determined to be a function of both drop kinetic energy and momentum for individual drop heights, but the relationship varied with height. Mean peak force was proportional to the diameter squared times velocity cubed for all drop sizes and fall heights. Also, the peak forces were related to drop oscillation during fall. A nondimensional representation of impact force vs. time duration of impact was determined. (Author's abstract)
W87-09004

METHOD TO ESTIMATE SOIL LOSS FROM EROSION,
Illinois Univ. at Urbana-Champaign. Agricultural Experiment Station.
For primary bibliographic entry see Field 7B.
W87-09007

SEMIPORTABLE MULTISLOT DIVISOR FOR EROSION AND RUNOFF MEASUREMENTS,
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
For primary bibliographic entry see Field 7B.
W87-09010

STOCHASTIC MODEL FOR SEDIMENT YIELD USING THE PRINCIPLE OF MAXIMUM ENTROPY,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
V. P. Singh, and P. F. Krstanovic.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 781-793, May 1987. 15 fig, 3 tab, 48 ref, append.

Descriptors: *Soil erosion, *Stochastic process, *Model studies, *POME, *Sediment yield, *Runoff, Distribution, Calibrations, Probabilistic process.

The principle of maximum entropy was applied to derive a stochastic model for sediment yield from upland watersheds. By maximizing the conditional entropy subject to certain constraints, a probability distribution of sediment yield conditioned on the probability distribution of direct runoff volume was obtained. This distribution resulted in minimally prejudiced assignment of probabilities on the basis of given information. The parameters of this distribution were determined from such prior information about the direct runoff volume and sediment yield as their means and covariance. The stochastic model was verified by using three sets of field data and was compared with a bivariate normal distribution. The model predicted sediment yield reasonably accurately. (Author's abstract)
W87-09016

PHYSICAL AND BIOLOGICAL EFFECTS OF GRAVEL EXTRACTION IN RIVER BEDS,
CEMAGREF - Groupement d'Aix-en-Provence, Section Qualite des Eaux, BP99-13603, Aix-en-Provence, France.
For primary bibliographic entry see Field 4C.
W87-09049

GEOCHEMISTRY OF SOIL HUMIC SUBSTANCES,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
F. J. Stevenson.
IN: Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization. John Wiley and Sons, New York, NY. 1985. p 13-52, 14 fig, 8 tab.

Descriptors: *Geochemistry, *Soil chemistry, *Humic substances, Humic acid, Clays, Minerals, Pesticides, Cation exchange, Chemical reactions, Soil water.

Past and present concepts of the nature and origin of humic substances are discussed in terms of the structural chemistry of humic acids and relationships between the various humus fractions. Major consideration is given to the interactions of humic substances with clay minerals and trace elements, to sorption reactions involving pesticides and related organic compounds, and to the role of humic substances in rock weathering and the translocation of mineral matter. Other topics of interest include the contribution of humic substances to the cation exchange capacity of the soil, speciation of trace metals in the soil solution, chemical interactions involving pesticides and humic substances, and radiocarbon dating of soil humus. Humic substances represent a complex mixture of molecules of various sizes and shapes but no completely satisfactory scheme has been forthcoming for their extraction and purification. Major emphasis needs to be given to the development of procedures leading to the isolation of molecularly homogeneous fractions free of inorganic and organic impurities. Other areas requiring further study are: (1) genetic relationships between humic substances from diverse sources; (2) nature of the building blocks of humic substances; (3) structural arrangement of reactive functional groups; and (4) mechanisms whereby humic substances combine with trace elements and clay minerals. (See also W87-09067) (Author's abstract)
W87-09068

GEOCHEMISTRY OF HUMIC SUBSTANCES IN LAKE SEDIMENTS,
Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W87-09072

GEOCHEMISTRY OF HUMIC SUBSTANCES IN MARINE SEDIMENTS,

Institut Francais du Petrole, Rueil Malmaison (France). Dept. de Geochemie.
M. Vandenbroucke, R. Pelet, and Y. Debyser.
IN: Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization. John Wiley and Sons, New York, NY. 1985. p 249-273, 12 fig, 8 tab.

Descriptors: *Geochemistry, *Humic substances, *Marine sediments, Sedimentation, Organic matter, Chemical analysis, Degradation, Chemical reactions.

Humic substances occur in recent marine sediments and their amounts and compositions depend both on (1) the sedimentation environment, which influences the nature of the organic input and importance of alteration processes, and (2) the evolutionary stage of the organic matter. A brief review points out some chemical features of sedimentary humic substances revealed by a number of analytical methods: elemental analysis, infrared spectroscopy, nuclear magnetic resonance, degradative methods, and isotopic analysis. Based on samples obtained during the ORGON cruises, the main factors controlling the composition of marine humic substances present in the water-sediment interface are the origin of organic input and the redox potential of the environment during transportation of the organic matter to the sediment. This chapter discusses possible origins of humic substances in marine sediments and suggests that they can result either from polycondensation reactions of the degradation products of organic matter, or from oxidative degradation reactions. Formation of primary humic substances (polycondensation) leads mainly to insoluble humin-humic and fulvic acids are mainly secondary humic substances formed by oxidation of humin. Humic substances in marine sediments can be derived from organic material produced either in terrestrial or marine environments. Evolution of humic substances during burial of the sediment and their relation with the kerogen of ancient sediments is tentatively proposed to depend on their molecular size and functionality. (See also W87-09067) (Author's abstract)
W87-09076

ECONOMIC DIFFERENCES BETWEEN CUMULATIVE AND EPISODIC REDUCTION OF SEDIMENT FROM CROPLAND,
Illincis Univ. at Urbana-Champaign. Inst. for Environmental Studies.
P.-I. Wu, J. B. Braden, and G. V. Johnson.
Research Report 204, UILU-WRC-86-204, September 1986. 129 p, 7 fig, 39 tab, 89 ref, append. Water Resources Center Project No. S-099-ILL.

Descriptors: *Sedimentation, *Model studies, *Economic aspects, *Crops, *Sediment load, Sediment control, Surface runoff, Simulation analysis, Storm water, Cost analysis, Agriculture.

Methods for reducing cumulative sediment loads from cropland are compared with methods for reducing sediment loads from extreme storms. The issue is whether the optimal means of controlling cumulative loads are very different from the optimal controls for storm event loads. Differences are described in terms of costs and management practices. The analysis entailed developing a storm-event simulation model analogous to the SEDEC sedimentation economics model. The analogue model was used to identify the respective optimal cropland management strategies for various extreme storm conditions. These strategies were then analyzed using the annual average SEDEC, and the optimal strategies from SEDEC were analyzed for their storm-event properties. The comparisons permit conclusions concerning the relative effectiveness of management strategies for achieving cumulative sediment goals versus storm-event load goals. Data for a 223 study site in the Highland-Silver Lake Watershed in Southwestern Illinois were analyzed using this approach. The study produced four main conclusions. First, control costs for episodic sediment loads were consistently higher than the costs for proportionate reductions in annual average loads. Furthermore, strategies for reducing cumulative loads generally achieve less than proportionate reductions in cumulative loads. Second, the highest control costs were generally for the most extreme storms. Third, contour cultivation is a key element of efficient management strategies for row crops. Finally, where a permanent grass crop is grown adjacent to the stream, there is generally little more to be gained by changing upslope management practices. This suggests that grass strips along streams would greatly reduce the need to modify farming practices elsewhere in order to limit sedimentation. (See also W87-09067) (Author's abstract)
W87-09090

MAN-INDUCED GRADIENT ADJUSTMENT OF THE SOUTH FORK FORKED DEER RIVER, WEST TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 6G.
W87-09206

NEW METHOD FOR DETERMINING THE CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS IN SEDIMENT INTERSTITIAL WATER,
Environmental Sciences Div. Lawrence Livermore National Lab., Livermore, CA 94550.
For primary bibliographic entry see Field 5A.
W87-09233

MECHANICS OF SEDIMENT TRANSPORTATION AND ALLUVIAL STREAM PROBLEMS,
University of Roorkee (India).
R. J. Garde, and K. G. Ranga Raju.
Second Edition. John Wiley and Sons, New York, NY. 1985. 618 p.

Descriptors: *Sediment transport, *Alluvial streams, *Streams, *Sediments, Flow profiles, Bed load, Suspended solids, Sampling, Rivers, Currents, Pipes.

The authors summarize and synthesize the vast amount of information on sediment transport and problems related to alluvial streams scattered in numerous journals, monographs and other research publications. The contents of the book have been divided into two parts. The first part consisting of eight chapters deals with the theory of sediment transport and includes such aspects as properties of sediments, incipient motion condition, flow regimes, resistance to flow, bed load transport, suspended load transport and total load transport. The second part consisting of another eight chapters deals with applied problems such as sediment samplers and sampling, stable channels, alluvial streams, variations in stream bed elevation and plan forms, sediment control, river training, and miscellaneous problems such as model studies, mud flows, density currents and sediment transport through pipes. (Lantz-PTT)
W87-09337

SEDIMENT DIFFUSION IN PRIMARY SHALLOW RECTANGULAR CLARIFIERS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W87-09376

EROSION CONTROL OF SCOUR DURING CONSTRUCTION; REPORT 6: FINITE - A NUMERICAL MODEL FOR COMBINED REFRACTION AND DIFFRACTION OF WAVES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W87-09482

SUSPENDED PARTICULATE MATTER IN COMMENCEMENT BAY,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
E. T. Baker, and S. L. Walker.
NOAA Technical Memorandum OMPA-26, December 1982. 47 p, 27 fig, 4 tab, 8 ref.

Descriptors: *Sediment transport, *Fate of pollutants, *Suspended sediments, *Turbidity, *Sediments, *Commencement Bay, Estuaries, Particulate matter, Puget Sound, Bottom sediments, Salinity, Puyallup River, Water currents.

The distribution and transport of suspended particulate matter was surveyed in Commencement Bay, Puget Sound, during three periods in 1980-1981. The suspended particulates appeared as follows: a thin (<5 m) surface layer, a thick mid-depth low turbidity zone containing one or more high-turbidity layers, and a benthic turbidity layer of highly variable concentration and thickness. Scatter plots of salinity versus the suspended particulates concentration had the highest correlation during high runoff periods. Horizontal suspended matter transport averaged about 12.7 micrograms/sq cm/sec. Vertical particle flux averaged about 5.5 g/sq m/day at 25 m and >80 g/sq m/day in the bottom waters. Transport of suspended particulate matter was controlled as follows: surface layer--Puyallup River plume; mid-depth--bottom erosion near the river mouth; and bottom--daily erosion/deposition which added suspended particles to a strong and steady clockwise circulation. (Cassar-PTT)
W87-09498

PLANS AND EXPERIMENTS TO DEAL WITH LARGE AMOUNTS OF SEDIMENT IN HUNGARIAN MINES UNDER KARSTIC WATER HAZARD,
Mining Research Inst., Budapest (Hungary).
For primary bibliographic entry see Field 4C.
W87-09590

2K. Chemical Processes

DETERMINATION OF MONOMERIC AND POLYNUCLEAR ALUMINUM(III) SPECIES AND HYDROLYSIS CONSTANTS,
Ohio State Univ., Columbus. Water Resources Center.
For primary bibliographic entry see Field 1B.
W87-08611

PHOTOCHEMICAL TRANSFORMATIONS,
SRI International, Menlo Park, CA. Physical Organic Chemistry Dept.
For primary bibliographic entry see Field 5B.
W87-08682

POSSIBLE INFLUENCE OF THE COMPONENTS OF THE SOIL AND LITHOSPHERE ON THE DEVELOPMENT AND GROWTH OF NEOPLASMS,
European Institute of Ecology and Cancer, Brussels (Belgium).
E. G. Peteers.
Experientia EXPEAM, Vol. 43, No. 1, p 74-81, January 1987. 7 tab, 94 ref.

Descriptors: *Water quality effects, *Cancer, *Groundwater, *Geochemistry, *Geocarcinogens, *Trace elements, *Carcinogens, Soil composition, Selerium, Wastewater.

A review of the background soil-cancer relationship is followed by an investigation of geocarcinogenic diseases in relation to soil composition. General factors are initially discussed such as soil concentration of selenium, Caesium-rubidium-potassium, trace elements, natural radioactivity risks, cancer risks in connection with recycled wastewater. In its final part, the study examines geocarcinogenic diseases linked with soil composition covering gastric cancer, cancer of the asophogus, urinary, breast, and bronchial cancer, pleural mesothelimae and bone cancer. (Author's abstract)
W87-08693

ROLE OF CUPRIC IONS IN THE GENERATION OF SUPEROXIDE IN NATURAL WATERS,
Universidade Estadual de Campinas (Brazil). Inst. de Quimica.
W. F. Jardim, M. I. Solda, and S. M. N. Gimenez.

The Science of the Total Environment STENDL, Vol. 58, No. 1/2, p 47-54, December 1986. 3 fig, 2 tab, 15 ref. FAPESP Scholarship 84/0635-1.

Descriptors: *Chemical reactions, *Copper, *Superoxide, *Natural waters, *Photochemistry, Ions, Organic compounds, Hydrogen peroxide, Ligands, Toxicity.

Photochemical generation of superoxide ions in water bodies has been associated with both synthetic and naturally occurring organic compounds. Indirect superoxide measurements are usually made by determining the concentration of hydrogen peroxide (as a product of superoxide dismutation), or by measuring the amount of nitrite produced when superoxide oxidizes hydroxylamine. Evidence that, under alkaline conditions, cupric ions generate superoxide in natural waters by a very sensitive catalytic reaction was collected. This reaction is enhanced by hydroxyl and borate ions. Strong natural and synthetic ligands inhibit the reaction, suggesting that only free or hydrolyzed species are involved. Copper speciation studies were performed using this technique. These results bring a new parameter for evaluating copper toxicity to the aquatic biota, i.e. the toxicity via superoxide ions. (Author's abstract)
W87-08716

CHEMISTRY OF THE RIVER NIGER I. MAJOR IONS,
National Water Research Inst., Burlington (Ontario).
J. O. Nriagu.
The Science of the Total Environment STENDL, Vol. 58, No. 1/2, p 81-88, December 1986. 1 fig, 3 tab, 27 ref.

Descriptors: *River Niger, *Water chemistry, Ions, Metals, Nutrients, Anions, Cations, Seasonal variation, Weathering.

The pH and concentrations of Ca, Mg, Na, K, Fe, SO4, NO3, Cl, F, and HCO3 in River Niger water were measured during the peak and lean flow regimes. The concentrations of SO4 (0.34 mg/L) and Cl (0.46 mg/L) rank among the lowest ever reported for the major rivers of the world. The dissolved solids show a pronounced seasonality, the levels generally being significantly elevated during the dry season (December to April) when the river loses a large fraction of its water. A comparison of the basin loss rate by river transport against the inputs from the atmosphere shows that the terrestrial ecosystems retain most of the major ions deposited via the atmosphere. The hydrochemistry of the River Niger is thus determined primarily by the weathering of the Precambrian Shield rocks, and little of the atmospheric inputs into the drainage basin seem to actually get into the river.(See also W87-08720) (Author's abstract)
W87-08719

CHEMISTRY OF THE RIVER NIGER II. TRACE METALS,
National Water Research Inst., Burlington (Ontario).
J. O. Nriagu.
The Science of the Total Environment STENDL, Vol. 58, No. 1/2, p 89-92, December 1986. 2 tab, 20 ref.

Descriptors: *River Niger, *Water chemistry, *Trace metals, Drainage basins, Transport, Metals.

The average concentrations of copper (140 ng/L) and cadmium (< 10 ng/L) in River Niger water are among the lowest in a major river. Phases leachable by dilute acids account for 30-50% of the particulate metal load of the river. On a global basis, the delivery of metals by the River Niger seems to represent a tiny fraction of the fluvial input into the oceans. Assuming that the drainage basin of the River Niger is representative of those of the other major rivers on the continent, the transport of metals to the oceans by African rivers is estimated to be 280, 900, 620, 660 and < 20 t/year, respectively, for Cu, Ni, Zn, Co and Cd. These data are orders of magnitude lower than what one finds in the literature, and point to the fact that the riverine flux of metals from the other regions of the world needs to be re-evaluated. (See also W87-08719) (Author's abstract)
W87-08720

STAGNANT SULPHIDIC BASIN WATERS,
Chalmers University of Technology, Goteborg (Sweden). Dept. of Analytical and Marine Chemistry.
D. Dyrssen.
The Science of the Total Environment STENDL, Vol. 58, No. 1/2, p 161-173, December 1986. 6 fig, 4 tab, 32 ref.

Descriptors: *Stagnant water, *Sulfides, *Chemical reactions, *Seawater, Organic matter, Sulfates, Alkalinity, Black Sea, Trace metals.

The two main conditions for the formation of sulfidic seawater are the restriction of water exchange and the input of decomposable organic matter. The stoichiometry of sulfate reduction gives a relation between titration alkalinity and sulfide concentration, which, however, is not the one found experimentally in the Black Sea. Computer analysis of the potentiometric titration of sulfide with mercury chloride elucidates the two equivalence points. The difference between them gives the concentration of thiols. The concentrations of trace metals should increase with increasing sulfide may explain the low concentrations of trace metals in sulfidic seawater. Calculations on titration alkalinity indicate a slow build-up of excess alkalinity in stagnant sulfidic basin waters. (Author's abstract)
W87-08722

ADSORPTIVE BEHAVIOR OF BUTYLTIN COMPOUNDS UNDER SIMULATED ESTUARINE CONDITIONS,
New Hampshire Univ., Durham. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W87-08730

HEAVY METALS IN LAKE KINNERET (ISRAEL): II. HYDROGEN SULFIDE DEPENDENT PRECIPITATION OF COPPER, CADMIUM, LEAD AND ZINC,
Bayreuth Univ. (Germany, F.R.). Dept. of Hydrology.
For primary bibliographic entry see Field 2H.
W87-08761

CARBON ISOTOPE FRACTIONATION AND CHANGES IN THE FLUX AND COMPOSITION OF PARTICULATE MATTER RESULTING FROM BIOLOGICAL ACTIVITY DURING A SEDIMENT TRAP EXPERIMENT IN LAKE GREIFEN, SWITZERLAND,
Woods Hole Oceanographic Institution, MA.
For primary bibliographic entry see Field 2H.
W87-08867

FREE AMINO ACIDS IN LAKES: CONCENTRATIONS AND ASSIMILATION RATES IN RELATION TO PHYTOPLANKTON AND BACTERIAL PRODUCTION,
Royal Veterinary and Agricultural University, Frederiksberg C. (Denmark). Dept. of Microbiology.
For primary bibliographic entry see Field 2H.
W87-08868

VOLATILIZATION LOSS OF NITROGEN FROM SUBMERGED SALINE SOIL,
Central Soil Salinity Research Inst., Research Station Canning Town (India).
For primary bibliographic entry see Field 2G.
W87-08892

SPATIAL VARIABILITY IN THE CHEMICAL COMPOSITION OF SNOWCOVER IN A SMALL, REMOTE, SCOTTISH CATCHMENT,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W87-08945

SEASONAL AND SPATIAL TRENDS IN SOUTH GREENLAND SNOW CHEMISTRY,
New Hampshire Univ., Durham. Inst. for the Study of Earth, Oceans and Space.
For primary bibliographic entry see Field 5B.
W87-08946

SCAVENGING OF ATMOSPHERIC SULFATE BY ARCTIC SNOW,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2C.
W87-08947

EFFECT OF 'WHITING' ON OPTICAL PROPERTIES AND TURBIDITY IN OWASCO LAKE, NEW YORK,
Upstate Freshwater Inst., Syracuse, NY.
For primary bibliographic entry see Field 2H.
W87-08966

KINETICS OF SULFATE ADSORPTION AND DESORPTION BY CECIL SOIL USING MISCIBLE DISPLACEMENT,
Clemson Univ., SC. Dept. of Horticulture.
For primary bibliographic entry see Field 2G.
W87-08995

EVALUATION OF NATURAL TRACERS IN AN ACIDIC AND METAL-RICH STREAM,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 7B.
W87-09021

GEOCHEMISTRY OF SOIL HUMIC SUBSTANCES,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
For primary bibliographic entry see Field 2J.
W87-09068

NATURE OF NITROGEN IN HUMIC SUBSTANCES,
Chemical and Biology Research Inst., Research Branch, Agriculture Canada, Ottawa, Ontario.
For primary bibliographic entry see Field 2H.
W87-09078

EXTRACTION OF HUMIC SUBSTANCES FROM SOIL,
Birmingham Univ. (England). Dept. of Chemistry.
For primary bibliographic entry see Field 7B.
W87-09079

FRACTIONATION OF SOIL HUMIC SUBSTANCES,
Lincoln Coll., Canterbury (New Zealand). Dept. of Soil Science.
For primary bibliographic entry see Field 2G.
W87-09081

FRACTIONATION TECHNIQUES FOR AQUATIC HUMIC SUBSTANCES,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W87-09082

ANALYTICAL METHODOLOGY FOR ELEMENTAL ANALYSIS OF HUMIC SUBSTANCES,
Huffman Laboratories, Inc., Wheat Ridge, CO.
For primary bibliographic entry see Field 7B.
W87-09083

IMPLICATIONS OF ELEMENTAL CHARACTERISTICS OF HUMIC SUBSTANCES,
Arizona Univ., Tucson. Dept. of Chemistry.

For primary bibliographic entry see Field 7B.
W87-09084

MOLECULAR SIZE AND WEIGHT MEASUREMENTS OF HUMIC SUBSTANCES,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 7B.
W87-09085

ACIDIC FUNCTIONAL GROUPS OF HUMIC SUBSTANCES,
Georgia Inst. of Tech., Atlanta. School of Geophysical Sciences.
E. M. Perdue.
IN: Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization. John Wiley and Sons, New York, NY. 1985. p 493-526, 8 fig, 1 tab.

Descriptors: *Acidic functional groups, *Humic substances, *Humic acids, *Chemical analysis, Organic compounds, Statistical studies, Mathematical models, Hydrogen ion concentration, Acidity, Potentiometric level.

A detailed discussion of the factors that affect the acidities of organic acids is presented, with emphasis on statistical, electrostatic, and delocalization effects. From such considerations and the very high degree of oxygen substitution in humic substances, it can be concluded that humic substances must contain a complex mixture of noidentical acidic functional groups. Given this view of humic substances, quantitative methods of functional group analysis and mathematical models of proton binding have been evaluated. Although all potentiometric methods of functional group analysis are inherently operational, the total acidity can be determined by the barium hydroxide method, if appropriate precautions are taken to remove all colored material from the reaction mixtures prior to the final titration. Any method that purportedly distinguishes between different classes of functional groups should be used with full awareness of the operational nature of the results that will be obtained. If potentiometric data are augmented with calorimetric and/or spectroscopic data, more accurate estimates of functional group concentrations may possibly be obtained. Until recently, most mathematical models that were used to describe proton binding by humic substances were far too simple, and, consequently, served only as empirical curve-fitting equations. More recently, several authors have used mathematical models that treat humic substances as having a continuous distribution of acidic functional groups. These more realistic models are highly recommended and are expected to find greater acceptance in the near future. (See also W87-09067) (Author's abstract)
W87-09086

SPECTROSCOPIC METHODS (OTHER THAN NMR) FOR DETERMINING FUNCTIONALITY IN HUMIC SUBSTANCES,
Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.
For primary bibliographic entry see Field 7B.
W87-09087

APPLICATION OF NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY FOR DETERMINING FUNCTIONALITY IN HUMIC SUBSTANCES,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 7B.
W87-09088

CHEMISTRY OF NATURAL WATERS,
S. D. Faust, and O. M. Aly.
Butterworths, Boston, MA. An Ann Arbor Science Book. 1981. 400 p.

Descriptors: *Water quality, *Chemical analysis, *Pollutant identification, Groundwater, Surface water, Potable water, Water quality control, Biological properties.

Increasing concern is being expressed about the quality of fresh ground and surface waters and oceanic waters in the environment. One of the highest priority uses is, of course, ingestion of water by humans. Consequently, it is demanded that potable water should have a quality to meet a rather rigid regimen of standards. On the other hand, it has been recognized that natural waters have uses other than drinking by man. For example, water quality is extremely important to freshwater and marine aquatic life, for industrial and agricultural uses, and for recreation and esthetic uses. These latter uses of water have moved the governmental and scientific communities to establish quality criteria for these various uses of natural waters. There are many natural factors, physical, chemical and biological, that affect water quality. There are also many anthropogenic influences on water quality. This volume attempts to document the natural chemical factors. Wherever appropriate, however, some physical and biological aspects are cited. (Lantz-PTT)
W87-09149

ADSORPTION OF INORGANIC POLLUTANTS IN AQUATIC SYSTEMS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-09194

REMOVAL OF MULTIVALENT METAL CATIONS FROM WATER USING MICELLULAR-ENHANCED ULTRAFILTRATION,
Oklahoma Univ., Norman.
J. F. Scamehorn, R. T. Ellington, S. D. Christian, B. W. Penney, and R. O. Dunn.
AIChE Symposium Series, Vol. 82, No. 250, p 48-58, February 1987. 7 fig, 1 tab, 22 ref.

Descriptors: *Water treatment, *Ultrafiltration, *Metals, *Cations, *Anions, Copper.

In this application of micellar-enhanced ultrafiltration (MEUF), anionic surfactant is added to water at concentrations well above the critical micelle concentration. Multivalent cationic heavy metals adsorb on the resulting highly negatively charged micelles. The solution is then ultrafiltered using membranes with pore sizes small enough to block passage of micelles. Electroneutrality requires that the adsorbed heavy metals also be rejected by the membrane. The permeate contains both heavy metals and surfactant in very low concentrations. In this work, divalent copper was used as a model heavy metal cation. When it is present in dilute concentrations, rejections of 99.8% are observed, demonstrating that MEUF can be extremely effective in this separation. The permeate purity decreases as the metal concentration in the feed increases, the added surfactant concentration is reduced, the solution is progressively ultrafiltered to higher concentrations, or added monvalent salt is present in solution. Membranes with pore sizes of molecular weight cut-offs of 20,000 or below produce excellent rejections in this application of MEUF. (Authors abstract)
W87-09223

CHEMICAL CHANGES OF ORGANIC COMPOUNDS IN CHLORINATED WATER: XII. GAS CHROMATOGRAPHIC-MASS SPECTROMETRIC STUDIES OF THE REACTIONS OF METHYLNAPHTHALENES WITH HYPOCHLORITE IN DILUTE AQUEOUS SOLUTION,
Tokyo Univ. of Science (Japan). Faculty of Pharmaceutical Sciences.
S. Onodera, T. Muratani, N. Kobatake, and S. Suzuki.
Journal of Chromatography JOCRAM, Vol. 370, No. 2, p 259-274, December 1986. 10 fig, 3 tab, 40 ref.

Descriptors: *Chemical reactions, *Water treatment, *Chlorination, Wastewater treatment, Organic compounds, Gas chromatography, Mass spectrophotometry, Methylation.

The products of aqueous chlorination reactions of naphthalene, 1- and 2-methylnaphthalenes, 1,2-, 1,3-, 1,4-, 1,5-, 1,8-, and 2,6-dimethylnaphthalenes and 2,3,5-trimethylnaphthalene with hypochlorite have been determined by gas chromatography-mass spectrometry. They included chloro-substituted, oxygenated (quinones) and hydroxylated (phenols compounds which were readily formed at room temperature. The extent of the reactions was shown to depend on the pH, the initial concentrations of both compounds and the number of methyl substituents and their positions. Monochlorinated compounds were identified in the chlorinated water under those conditions utilized for water treatment. (Author's abstract)
W87-09224

KINETICS AND MECHANISMS OF HYPOCHLORITE OXIDATION OF ALPHA-AMINO ACIDS AT THE TIME OF WATER DISINFECTION (CINETIQUES ET MECHANISMES DE L'ACTION OXYDATIVE DE L'HYPOCHLORITE SUR LES ACIDES ALPHA-AMINES LORS DE LA DESINFECTION DES EAUX),
Lab. de genie sanitaire, Ecole Nationale de la Sante Publique (ENSP), Avenue du Professeur Leon Bernard, 35043 Rennes Cedex, France.
For primary bibliographic entry see Field 5F.
W87-09274

PRINCIPLES OF AQUATIC CHEMISTRY,
Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
F. M. M. Morel.
John Wiley and Sons, New York, NY. 1983. 446 p.

Descriptors: *Water chemistry, *Chemistry, *Aquatic environment, *Chemical properties, *Chemical analysis, Kinetics, Thermodynamics, Hydrogen ion concentration, Chemical precipitation, Oxidation.

The central position of aquatic chemistry in the natural sciences gives it an increasing popularity in science and engineering curricula; it also makes it a difficult topic to teach for it requires exploring some aspects of almost all sciences. This text is intended for first year graduate students and advanced undergraduates. The first three chapters deal with conservation of mass, thermodynamics and kinetics, and chemical equilibrium calculations, providing a general background indispensible for the rest of the book. In the next five chapters, the subject of aquatic chemistry proper is developed following the accepted divisions of acid-base, precipitation-dissolution, coordination, redox, and surface chemistry. Chapters 5 and 6 focus more on chemical principles and less on the intricate realities of natural waters which are introduced more fully in the later chapters. (Lantz-PTT)
W87-09305

AQUATIC CHEMISTRY: AN INTRODUCTION EMPHASIZING CHEMICAL EQUILIBRIA IN NATURAL WATERS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
For primary bibliographic entry see Field 2A.
W87-09340

FREE AMINO ACIDS IN MARINE RAINS: EVIDENCE FOR OXIDATION AND POTENTIAL ROLE IN NITROGEN CYCLING,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
For primary bibliographic entry see Field 2B.
W87-09349

ORIGIN OF BRINE IN THE SAN ANDRES FORMATION, EVAPORITE CONFINING SYSTEM, TEXAS PANHANDLE AND EASTERN NEW MEXICO,
Texas Univ. at Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 2F.
W87-09351

SELENIUM IN THE TRIBUTARIES OF THE ORINOCO IN VENEZUELA,
Massachusetts Inst. of Tech., Cambridge. Dept. of

Earth and Planetary Sciences.
H. S. Yee, C. I. Measures, and J. M. Edmond.
Nature NATUAS, Vol. 326, No. 6114, p 686-689, April 1987. 2 fig, 1 tab, 14 ref.

Descriptors: *Trace elements, *Orinoco River, *Selenium, *Drainage basins, Geochemistry, Tributaries, Venezuela, Rivers, Weathering, Heavy metals.

The drainage basins of large pristine rivers are valuable natural laboratories for the study of trace element geochemistry. Their relatively unperturbed nature provides the opportunity to establish natural concentration ranges thus giving a background against which anthropogenically impacted environments may be understood. The wide range of geological provinces present in large basins also provides an opportunity to identify the underlying geochemical parameters which determine the sources and transport of the elements in the hydrosphere. (Author's abstract)
W87-09406

SEASONAL EFFECTS ON GROUND-WATER CHEMISTRY OF THE OUACHITA MOUNTAINS,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
K. F. Steele, W. M. Fay, and P. N. Cavendor.
Available from the National Technical Information Service, Springfield, VA 22161, as DE83-001216, A04 in paper copy, A01 in microfiche. DPST-81-141-24. August 1982. 63 p, 4 fig, 19 tab, 24 ref. Contract No. DE-AC09-76SR00001.

Descriptors: *Geochemistry, *Groundwater, *Water quality, *Arkansas, Ouachita Mountains, Seasonal variation.

Samples from 13 groundwater sites (10 springs and 3 wells) in the Ouachita Mountains were collected nine times during a 16-month period. Daily sampling of six sites was carried out over an 11-day period, with rain during this period. Finally, hourly sampling was conducted at a single site over a 7-hour period. The samples were analyzed for pH, conductivity, temperature, total alkalinity, nitrate, ammonia, sulfate, phosphate, chloride, silica, Na, K, Li, Ca, Mg, Sr, Ba, Fe, Mn, Zn, Cu, Co, Ni, Pb, Hg, Br, F, V, Al, Dy, and U. Despite the dry season during the late summer, and wet seasons during late spring and late fall in the Ouachita Mountain region, there was no significant change in the groundwater chemistry with season. Likewise, there was no significant change due to rain storm events (daily sampling) or hourly sampling. (Author's abstract)
W87-09428

ORIENTATION STUDY OF ST. FRANCOIS MOUNTAIN AND DECATURVILLE PRECAMBRIAN AREAS, MISSOURI,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
K. F. Steele, and W. M. Fay.
Available from the National Technical Information Service, Springfield, VA 22161, as DE83-001215, A04 in paper copy, A01 in microfiche. GJBN--200-82, August 1982. 72 p, 7 tab, 7 ref. Contract No. DE-AC09-76SR00C01.

Descriptors: *Geochemistry, *Groundwater, *Water quality, *Uranium, Streams, St. Francois Mountains, Missouri.

Approximately 310 groundwater and 135 stream sites were sampled in the St. Francois Mountain and Decaturville Precambrian areas of Missouri. A significant number of felsic volcanics and granite outcrops, some containing rather high uranium concentrations, are present. The combination of the uranium-rich source rock and the onlapping conglomerate and shaley Lamotte sequence provides a favorable environment for uranium deposits. Conductivity, pH, total alkalinity, temperature, nitrate, ammonia, phosphate, and sulfate were measured in all water samples (both groundwater and stream water). Additional water was collected, filtered and reacted with a resin which was then analyzed by neutron activation analysis for U, Br, Cl, F, Mn, Na, Al and Dy. In addition, groundwater samples were analyzed for He. The stream sediments were analyzed by neutron activation for U, Th, Hf, Ce, Fe, Mn, Sc, Ti, V, Al, Dy, Eu, La, Sm, Yb and Lu. (Author's abstract)
W87-09459

2L. Estuaries

OPTIMIZATION OF CLOSURE OPERATIONS IN A TIDAL BASIN DURING A STORM-SURGE,
Osservatorio Geofisico Sperimentale, Trieste (Italy).
For primary bibliographic entry see Field 4A.
W87-08610

GEOCHEMICAL PARTITIONING OF HEAVY METALS IN SEDIMENTS OF THREE ESTUARIES ALONG THE COAST OF RIO DE JANEIRO (BRAZIL),
Universidade Federal Fluminense, Niteroi (Brazil). Dept. de Geoquimica.
C. M. M. De Souza, M. H. D. Pestana, and L. D. Lacerda.
The Science of the Total Environment STENDL, Vol. 58, No. 1/2, p 63-72, December 1986. 4 fig, 1 tab, 22 ref.

Descriptors: *Path of pollutants, *Geochemistry, *Heavy metals, *Sediments, *Estuaries, *Coastal waters, Salinity, Metals, Rio de Janeiro, Brazil.

The geochemical partitioning of Cu, Cd, Cr and Pb was studied in sediments of three estuaries along the coast of Rio de Janeiro. The results show that, under contaminated conditions, the lithogeneous fraction of the total metal concentration decreases in importance, and mobile fractions dominate. Dilution with less contaminated marine sediments and the effect of salinity on metal behavior could only be observed in the uncontaminated estuary. Under oxic conditions the reducible fraction is the more important sink for metals among the mobile phases. However, in the area with high organic sewage inputs, the oxidizable fraction can account for the greater fraction of total metal content. This latter result suggests a synergistic effect between organic pollution and metal contamination, since metals in oxidizable forms may be remobilized during mixture with oxic marine sediments. (Author's abstract)
W87-08717

PREDATION RISK AND USE OF INTERTIDAL HABITATS BY YOUNG FISHES AND SHRIMP,
Georgia Univ., Sapelo Island. Marine Inst.
R. T. Kneib.
Ecology ECOLAR, Vol. 68, No. 2, p 379-386, April 1987. 2 fig, 3 tab, 44 ref. NSF Grant BSR-8300088.

Descriptors: *Salt marshes, *Intertidal areas, *Fish, *Shrimp, *Predation, Crustaceans, Killifish, Fish populations, Tidal effects, Tidal marshes, Populations, Marshes, Mortality, Habitats, Larval growth stage, Larvae.

Salt marsh populations of the killifish Fundulus heteroclitus and the grass shrimp Paleomonetes pugio exhibit similar age-specific habitat-use patterns. At low tide, the young of both species are found in shallow aquatic microhabitats on the surface of the intertidal marsh, separated from the adults, which reside in adjacent subtidal creek habitats. As a test of the hypothesis that predation is responsible for the segregation of age classes by habitat, 5 sq m enclosures containing artificial habitats were used to maintain two size classes (45-60 millimeters and 70-90 millimeters total length) of adult killifish on the intertidal marsh surface both in the presence and absence of adult grass shrimp. During the 10-week experiment, larval killifishes and post-larval grass shrimp recruited into the enclosures through the mesh walls. The numbers of young killifishes in enclosures that contained adult fish of either size were <5% of those in plots that excluded both adult fish and shrimp. The overall effect of fish on the abundance of shrimp postlarvae was not as great because large adults had less effect on young shrimp than did small adults. However, adult shrimp mortality was higher in enclosures that contained large fish than in those that contained small fish. Enclosures that received only adult grass shrimp additions contained approximately 50% fewer young killifishes than those from which both adult fish and shrimp were excluded. Adult shrimp had no effect on the abundance of shrimp postlarvae. Treatment effects were enhanced with increasing elevation in the intertidal zone. The experimental results suggest that young killifishes and shrimp remain in the intertidal zone at low tide as an adaptation to avoid a high risk of mortality from concentrations of predatory adults in subtidal marsh habitats. (Author's abstract)
W87-08787

SALINITY DURING EMBRYONIC DEVELOPMENT INFLUENCES THE RESPONSE TO SALINITY OF GASTEROSTEUS ACULEATUS L. (TRACHURUS),
Laval Univ., Quebec. Dept. de Biologie.
For primary bibliographic entry see Field 2H.
W87-08793

HYDRODYNAMICS AND STRUCTURE: INTERACTIVE EFFECTS ON MEIOFAUNA DISPERSAL,
Wabash Coll., Crawfordsville, IN. Dept. of Biology.
M. A. Palmer.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 104, No. 1-3, p 53-68, December 1986. 2 fig, 8 tab, 45 ref. NSF Grant OCE-8509904.

Descriptors: *Limnology, *Hydrodynamics, *Substrates, *Migration, *Benthic fauna, *Marine biology, *Mud flats, *Flow, Aquatic animals, Benthos, Fauna, Spartina, Ecology, Erosion, Sediments, Copepods, Crustaceans, Nematodes.

The hypothesis that two aspects of the physical environment, hydrodynamics and aboveground structure, interactively influence meiofauna dispersal was tested by experiments performed in a recirculating laboratory flume using sediment boxcores from two sites - from within a vegetated (Spartina) region and from an adjacent unvegetated mudflat. A 2 x 3 factorial design was used with three flow levels and structure either present or absent. The number of meiofauna drifting was determined for each treatment combination. The number of meiofauna emerging was determined under no-flow conditions with structure present and with structure absent. Flow and structure influenced drift from the mud boxcores with the greatest number of fauna drifting at high flows and when structure was present. For the Spartina boxcores, the number of meiofauna drifting increased as flow increased but was not influenced by the presence of structure. For both mud and Spartina boxcores, emergence of copepods was enhanced when structure was present. It is concluded that, for both sites, surface activity of copepods was enhanced in the presence of structure; yet the copepods were able to minimize downstream transport when Spartina culms were present. Nematode emergence was not influenced by structure. (Author's abstract)
W87-08838

DIGESTION OF CARBOHYDRATES AND PROTEIN BY GAMMARUS MUCRONATUS SAY (AMPHIPODA),
Mount Allison Univ., Sackville (New Brunswick). Dept. of Biology.
F. Barlocher, and S. L. Howatt.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 104, No. 1-3, p 229-237, December 1986. 1 fig, 6 tab, 25 ref.

Descriptors: *Digestion, *Gammarus, *Amphipods, *Carbohydrates, *Proteins, *Salt marshes, *Enzymes, *Biodegradation, *Physiological ecology, Organic compounds, Canada, Marshes, Metabolism, Starch, Microbial degradation, Sugars, Amino acids, Environment, Estuarine environ-

ment, Spartina, Aquatic life, Aquatic animals, Aquatic plants, Mud, Cladophora, Chlorophyta, Algae, Detritus, Organic matter.

A study was undertaken to determine whether fungal enzymes ingested with food remain active in the gut of the amphipod Gammarus mucronatus and assist with the digestion of detritus. Animals and substrata for enzyme extractions were collected from salt-marsh pools on the edge of the Bay of Fundy in New Brunswick, Canada. G. mucronatus showed weak or no enzymatic activity toward structural plant polysaccharides, but could digest starch and laminarin. It was found to possess several enzymes capable of breaking glycosidic linkages in small molecules, similar to those that might be released during microbial breakdown of plant polysaccharides. G. mucronatus extracts were able to release sugars and amino acids from Spartina alterniflora, Enteromorpha sp., Cladophora sp., and mud collected from salt-marsh pools. A cellulase produced by Buergenerula sparatinae on S. alterniflora remained active when ingested by G. mucronatus. Spartina detritus accounted for between 4% and 27% of the gut content of G. mucronatus collected from pools. (Author's abstract)
W87-08839

EMBRYOTOXICITY, TERATOGENICITY, AND ARYL HYDROCARBON HYDROXYLASE ACTIVITY IN FORSTER'S TERNS ON GREEN BAY, LAKE MICHIGAN,
For primary bibliographic entry see Field 5C.
W87-08841

EFFECT OF INGESTED BENZO(A)PYRENE AND CADMIUM ON TISSUE ACCUMULATION, HYDROXYLASE ACTIVITY, AND INTESTINAL MORPHOLOGY OF THE BLACK SEA BASS, CENTROPRISTIS STRIATA,
National Marine Fisheries Service, Charleston, SC. Charleston Lab.
For primary bibliographic entry see Field 5C.
W87-08842

SEASONALITY OF BLUE MUSSEL, MYTILUS EDULIS L., LARVAE IN THE DAMARISCOTTA RIVER ESTUARY, MAINE, 1969-77,
Maine Univ. at Orono. Ira C. Darling Center.
G. S. Podniesinski, and B. J. McAlice.
Fishery Bulletin FSYBAY, Vol. 84, No. 4, p 995-1001, October 1986. 3 fig, 2 tab, 34 ref. UMO-UNH Sea Grant R/FD-99.

Descriptors: *Temperature effects, *Estuaries, *Limnology, *Seasonal variation, *Mytilus, *Larval growth stage, *Maine, *Estuarine environment, *Spawning, *Phenology, *Physiological ecology, Growth stages, Mussels, Mollusks, Environment, Life history studies, Water temperature, Plankton, Phytoplankton, Aquatic plants, Population.

An 8-year plankton record of Mytilus larval abundance in the Damariscotta River estuary (ME) (1969-1977) was examined to observe long-term variability in spawning and larval occurrence. Spawning began in late May or early June when temperatures reached 10-12.5 C. The average date when spawning began was June 4, with a standard deviation of about 7 days. The average number of degree days prior to spawning was 2,853, with a standard deviation of 368. No significant relationship was found between degree days and commencement of spawning or degree days and maximum larval abundance. Commencement of spawning may be related to the time of spring tides. In 7 years, spawning began within 5 days before and after a spring tide. Spawning appeared to cease as temperatures fell to 9-14 C in September and October. Mussel larvae appeared well after phytoplankton abundances had begun to increase, and disappeared before phytoplankton abundances fell to low winter levels. It is concluded that onset of spawning in these mussel populations is predictable, occurring when water temperature exceeds 10-12.5 C, and near the spring tide portion of the neap-spring cycle. Food does not appear to be limiting to either gametogenesis or larval development. (Author's abstract)
W87-08849

THEORY OF SECONDARY PRODUCTION CALCULATIONS FOR CONTINUOUSLY REPRODUCING POPULATIONS,
Melbourne Univ., Parkville (Australia). Dept. of Zoology.
W. J. Kimmerer.
Limnology and Oceanography LIOCAH, Vol. 32, No. 1, p 1-13, January 1987. 3 fig, 6 tab, 42 ref.

Descriptors: *Limnoloyg, *Secondary productivity, *Populations, *Mathematical equations, *Mathematical models, *Benthic environment, *Marine environment, Environment, Zooplankton, Benthos, Plankton, Growth, Mortality, Productivity, Mathematical studies, Mathematical analysis, Biomass.

The mathematics of secondary production are discussed and alternative formulae evaluated. It is noted that definitions and mathematical expressions currently used to calculate secondary production are based on the observation of development in cohorts. Most populations of marine zooplankton and many benthic populations do not meet the strict conditions necessary for measurement of growth and mortality in cohorts, and application of the mathematics used in cohort methods to such populations can lead to errors. It is concluded that a better approach is to assume approximate steady state and to determine integrated production (IP) over a time period from observations of the instantaneous production rate, PR. The determination of IP consists of two steps: measurement of PR, usually by a direct method, and integration. The value of IP determined from PR over a given time interval depends on assumptions about the trajectory of PR between samples. Several simple models are used to demonstrate that mortality need not be measured and that IP can be determined from sample data on PR. The best estimate of IP is a simple sum of PR values multiplied by appropriate time intervals. (Author's abstract)
W87-08862

ACUTE TOXICITY OF EMULSIFIABLE CONCENTRATIONS OF THREE INSECTICIDES COMMONLY FOUND IN NONPOINT SOURCE RUNOFF INTO ESTUARINE WATERS TO THE MUMMICHOG, FUNDULUS HETEROCLITUS,
South Carolina State Dept. of Health and Environmental Control, Columbia.
For primary bibliographic entry see Field 5C.
W87-08881

SEDIMENTATION AND BIOTURBATION IN A SALT MARSH AS REVEALED BY 210PB, 137CS, AND 7BE STUDIES,
South Carolina Univ., Columbia. Dept. of Geology.
P. Sharma, L. R. Gardner, W. S. Moore, and M. S. Bollinger.
Limnology and Oceanography LIOCAH, Vol. 32, No. 2, p 313-326, March 1987. 7 fig, 5 tab, 37 ref. NSF Grants OCE 81-00038, OCE 84-15964, and DEB 80-12165.

Descriptors: *Model studies, *Tracers, *Crab burrows, *Analytical methods, *Radionuclides, *Limnology, *Salt marshes, *Sedimentation, *Bioturbation, Lead isotopes, Cesium isotopes, Beryllium isotopes, Accumulation.

We report detailed depth profiles of the particle-reactive radionuclides 210Pb, 137Cs, and 7Be in sediment cores collected at five different sites from a salt marsh near North Inlet, South Carolina. Except for creekbank sites where bioturbation is intense, average recent accumulation rates determined by the 210Pb method (1.4-4.5 mm/yr) agreed with accumulation rates over the past 20 yr (1.3-2.5 mm/yr) with 137Cs as a stratigraphic marker. The mean rate of sea level rise over the past 50 yr determined from tide gauge records (3.0 mm/yr) is about the same as the sedimentation rate. Calculated 210Pb fluxes (0.93-1.55 dpm/sq cm/yr) in back-marsh areas are in good agreement with atmospheric measurements at New Haven, Connecticut, and 7Be fluxes (4.7-6.8 dpm/sq cm/yr) are lower by a factor of about three. Along creekbanks, however, both nuclides are about an order of magnitude greater than in back-marsh areas due to the greater intensity of fiddler crab burrowing on creekbanks. We present a mathematical model for regeneration of 210Pb at depth that can account for the observed difference in inventories between back marsh and creekbank by crab burrowing. We further suggest that intense crab burrowing is at least partly responsible for the enhanced growth of Spartina along creekbanks by virtue of its impact on the turnover of iron and sulfur in creekbank sediments. (Author's abstract)
W87-08932

RESUSPENSION IN THE SHALLOW SUBLITTORAL ZONE OF A MACROTIDAL ESTUARINE ENVIRONMENT: WIND INFLUENCE,
Ministere des Peches et des Oceans (Quebec). Inst. Maurice-Lamontagne.
S. Demers, J.-C. Therriault, E. Bourget, and A. Bah.
Limnology and Oceanography LIOCAH, Vol. 32, No. 2, p 327-339, March 1987. 6 fig, 3 tab, 49 ref. NSERC Strategic grant G0332.

Descriptors: *Wind effects, *Mixing, *Resuspension, *Phytoplankton, *Littoral zones, *Estuaries, *Limnology, Wind fields, Diatoms, Seasonal variation, Waves, Velocity, Biomass, Nutrient.

Several biological and physical variables were measured four times daily for 148 consecutive days at a fixed station to examine fluctuations of phytoplankton abundance in the littoral zone of the lower St. Lawrence estuary. On the seasonal scale, the pattern of variation of phytoplankton was characterized by a midsummer diatom bloom similar to that observed offshore in the pelagic zone. On the shorter time scale, chlorophyll a concentration in the littoral zone was highly variable and closely associated with variations in the wind field. No relationship, however, could be found between phytoplankton cell numbers and wind velocity. The possible influence of wind, tidal-induced upwelling, overturning eddies, and wave-induced mixing processes on resuspension was examined. The higher Chl a values observed irregularly at the sampling stations resulted from the mechanical resuspension of benthic diatoms due to wind, or wind-induced wave, mixing in the littoral zone. Wind velocities > 4 m/s were shown to cause significant resuspension of particulate organic matter (POC) in the water column. For winds > 6 m/s, there was no further increase in POC. These results suggest that the frequency of wind velocities > 4 m/s plays a significant role on secondary production in the littoral zone by providing an increased food supply to benthic and planktonic filter feeders, especially at times when phytoplankton biomass is normally low in the water column. (Author's abstract)
W87-08933

CHROMATOGRAPHIC STUDIES OF DISSOLVED ORGANIC MATTER AND COPPER-ORGANIC COMPLEXES ISOLATED FROM ESTUARINE WATERS,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
For primary bibliographic entry see Field 7B.
W87-08960

CONCENTRATIONS OF MERCURY IN NEAR SHORE SURFACE WATERS OF THE BAY OF BISCAY AND IN THE GIRONDE ESTUARY,
Institut Francais de Recherche pour l'Exploitation de la Mer, Nantes (France).
For primary bibliographic entry see Field 5A.
W87-08961

DISTRIBUTION AND ABUNDANCE OF HELICE TRIDENS (DE HAAN) BURROWS AND SUBSTRATUM CONDITIONS IN A NORTHEASTERN JAPAN SALT MARSH (CRUSTACEA; BRACHYURA),
Tohoku Univ., Sendai (Japan). Biological Inst.
S. Takeda, and Y. Kurihara.
Journal of Experimental Marine Biology and Ecol-

ogy JEMBAM, Vol. 107, p 9-19, 1987. 5 fig, 3 tab, 13 ref.

Descriptors: *Salt marshes, *Limnology, *Crab burrows, Silt, Clay, Water table, Distribution, Field tests, Helice, Japan.

The effects of the physical condition of the substratum on the distribution and abundance of mud-crab burrows were investigated. In the salt-marsh habitats studied, where burrows were abundant, there was a high proportion of silt-clay. In such conditions, the diameters of openings and the depths of the burrows were greater than those when the relative proportion of silt-clay was low. In the laboratory, it was found that with a low proportion of clay, mud-crabs did not dig burrows when the water content was high and thus equivalent to that in the marsh. When the proportion of silt-clay was low, the larger mud-crabs did not make burrows at the depth of the water table in the marsh, because the layer above the water table was too thin to allow construction of the burrow. The field observations could thus be explained by the results of experiments showing that the depth of the burrows was controlled by the depth of the water table and the relative proportion of silt-clay in the substratum. (Author's abstract)
W87-08987

IMMUNOLOGICAL DIETARY ANALYSIS OF TWO PENAEID SHRIMP SPECIES FROM A SOUTH CAROLINA TIDAL CREEK,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
J. Hunter, and R. J. Feller.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 107, p 61-70, 1987. 2 fig, 3 tab, 19 ref. NSF Grants DEB-12165 and OCE-8110148.

Descriptors: *Immunology, *Limnology, *Shrimp, *Diets, *Food habits, *Tidal rivers, South Carolina, Predation.

The natural, visually unrecognizable components of the diets of two species of penaeid shrimp were studied utilizing immunological methods. Seine samples of Penaeus aztecus Ives and P. setiferus (L.) were collected biweekly from May to November, 1983 in a tidal creek of North Inlet, South Carolina. Three size classes were established to examine possible ontogenetic shifts in diet as the shrimp grew. Immunoassays for P. aztecus indicated both macrofaunal and meiofaunal taxa present in all three size classes, with no single dominant prey. P. Setiferus proventricular contents, however, revealed consistent presence of three prey items (Palaemonetes pugio (Holthuis), Uca pugnax (Smith), and Sesarma reticulatum (Say), as well as gammarid amphipods, polychaetes, periwinkles, and foraminiferans. (Author's abstract)
W87-08988

ECOLOGY OF ESTUARIES, VOLUME I: PHYSICAL AND CHEMICAL ASPECTS,
GPU Nuclear Corp., Forked River, NJ. Environmental Controls Dept.
For primary bibliographic entry see Field 2H.
W87-09066

GEOCHEMISTRY OF HUMIC SUBSTANCES IN ESTUARINE ENVIRONMENTS,
Maine Univ., Walpole. Ira C. Darling Center for Research, Teaching and Service.
For primary bibliographic entry see Field 2H.
W87-09074

GEOCHEMISTRY OF HUMIC SUBSTANCES IN SEAWATER,
National Oceanic and Atmospheric Administration, Miami, FL. Atlantic Oceanographic and Meteorological Labs.
G. R. Harvey, and D. A. Boran.
IN: Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization. John Wiley and Sons, New York, NY. 1985. p 233-247, 9 fig, 3 tab.

Descriptors: *Geochemistry, *Humic substances, *Seawater, Fulvic acids, Humic acids, Chemical analysis, Water analysis, Lipids, Hydrogen, Carbon.

Marine humic substances have received very little attention because of their low concentration in seawater and the difficulties associated with obtaining enough sample for study. Recent developments have allowed gram quantities to be isolated conveniently. Seawater fulvic and humic acids have now been isolated from several diverse environments and in different seasons of the year. Spectral, chemical, and physical studies indicate that seawater humic substances are very similar wherever they are formed. Based on these observations a hypothesis proposed: seawater humic substances are derived from the free radical cross-linking of unsaturated lipids released into the water column. The hypothesis has been tested by laboratory synthesis by the proposed pathway and by correctly predicting the results of several chemical and biological reactions. A few problems with the structure still remain. The percent hydrogen is too low, the functionality of the nitrogen is not known, and there is more 13-C in the humic substances than in the starting lipids. (See also W87-09067) (Author's abstract)
W87-09075

GEOCHEMISTRY OF HUMIC SUBSTANCES IN MARINE SEDIMENTS,
Institut Francais du Petrole, Rueil Malmaison (France). Dept. de Geochemie.
For primary bibliographic entry see Field 2J.
W87-09076

GEOCHEMISTRY OF HUMIN,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2H.
W87-09077

THEORY OF FLUORESCENT IRRADIANCE FIELDS IN LAKES AND SEAS,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 5A.
W87-09193

BIOACCUMULATION POTENTIAL OF HETEROTROPHIC BACTERIA FOR LEAD, SELENIUM, AND ARSENIC,
Dept. of Pharmacy, Univ. of Port Elizabeth, P.O. Box 1600, Port Elizabeth 6000, South Africa.
For primary bibliographic entry see Field 5B.
W87-09240

DEGRADATION OF ANILINE AND CHLOROANILINES BY SUNLIGHT AND MICROBES IN ESTUARINE WATER,
Georgia Univ., Athens. Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W87-09271

SUPPRESSION OF PHOSPHATE LIBERATION FROM SEDIMENT BY USING IRON SLAG,
Tokai Regional Fisheries Research Lab., the Ministry of Agriculture, Forestry and Fisheries, Arasaki, Nagai, Yokosuka 238-03.
For primary bibliographic entry see Field 5G.
W87-09273

POWER-PLANT-RELATED ESTUARINE ZOOPLANKTON STUDIES,
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
For primary bibliographic entry see Field 5C.
W87-09316

HEAVY METAL CONCENTRATIONS IN THE LIVER OF THREE DUCK SPECIES: INFLUENCE OF SPECIES AND SEX,
Environmental and Community Medicine, UMDNJ-Robert Wood Johnson Medical School, Piscataway, NJ 08854, USA.
For primary bibliographic entry see Field 5B.
W87-09380

USE OF MONODISPERSED, FLUORESCENTLY LABELED BACTERIA TO ESTIMATE IN SITU PROTOZOAN BACTERIVORY,
Georgia Univ., Sapelo Island. Marine Inst.
For primary bibliographic entry see Field 2H.
W87-09388

DISPERSAL-MEDIATED COEXISTENCE OF MUD SNAILS (HYDROBIIDAE) IN AN ESTUARY,
Zoological Inst., Univ. of Munich; Seidlstrass 25, D-8000 Munchen 2, Federal Republic of Germany.
H. R. Siegismund, and J. Hylleberg.
Marine Biology MBIOAJ, Vol. 94, No. 3, p 395-402, April 1987. 4 fig, 1 tab, 25 ref.

Descriptors: *Hydrobiidae, *Estuaries, *Snails, *Salinity, *Denmark, Species composition, Distribution, Habitats, Rivers, Dispersal.

The distribution of the mud snails Hydrobia ventrosa (Montagu), H. neglecta Muus, and Potamopyrgus jenkinsi (Smith) was studied in the Kysing Fjord estuary, Denmark, from November 1977 to February 1979. The hydrobiids show habitat selection with regard to salinity but coexist in large areas of the estuary: P. jenkinsi at the innermost parts of the estuary together with H. ventrosa, with the latter species extending its distribution further to the mouth of the estuary, where H. neglecta dominates. H. ventrosa and H. neglecta are the only species that have permanent populations in the estuary. P. jenkinsi dies out in the estuary in the winter, but recolonizes there from a small river in the spring and builds up a population in the innermost parts of the estuary during the summer. H. ventrosa and H. neglecta coexist in the middle part of the estuary due to continued dispersal into this area. (Author's abstract)
W87-09422

SYSTEMATICS AND ECOLOGY OF LYNGBYA SPP. AND ASSOCIATED SPECIES (CYANOPHYTA) IN A NEW ENGLAND SALT MARSH,
New Hampshire Univ., Durham. Jackson Estuarine Lab.
K. K. Baker.
Journal of Phycology JPYLAJ, Vol. 23, No. 1, p 201-208, March 1987. 9 fig, 3 tab, 31 ref.

Descriptors: *Cyanophyta, *Salt marshes, *Lyngbya, Cell size, New England, Populations, Morphology, Algae, Cultures.

Field populations of the most abundant filamentous blue-green algae (cyanobacteria) from a northern New England salt marsh were examined for the presence of natural morphological clusters. A continuum in the distribution of average cell sizes and shapes for individual trichomes was evident. However, there was a high frequency of certain cell sizes (six clusters), which were also separated by several qualitative characters (end cell shape, granule location, and cell color). In clone cultures the trichomes of these clusters maintained the morphology of the original isolated trichome and thus morphology appeared to be stable. The clusters were either named according to Geitler's (1932) terminology or assigned numbers if no adequate descriptions were available: (1) Lyngbya and Phormidium spp., (2) Microcoleus chthonoplastes Thur. (3) Lyngbya sp. 1, (4) Lyngbya sp. 2, (5) Lyngbya aestuarii (Mert.) Liebmann. and, (6) Lyngbya sp. 3. All groups had maximum abundance in late summer. Microcoleus chthonoplastes occurred throughout the year, while Lyngbya aestuarii and Lyngbya sp. 3 occurred throughout the summer and fall. It is concluded that both field and culture information are useful in enhancing our knowledge of blue-green algal systematics. (Author's abstract)
W87-09423

SPECTRAL ANALYSIS OF COLUMBIA RIVER ESTUARY CURRENTS,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
B. P. Donnell, and W. H. McAnnally.
Availabe from the National Technical Information Service, Springfield, VA 22161, as ADA 161609, A06 in paper copy, A01 in microfiche. Technical Report HL-85-5, September 1985. Final Report. 120 p, 6 fig, 27 tab, 42 plates, append.

Descriptors: *Model studies, *Mathematical studies, Sedimentation, Sediments, Sedimentation rates, Sediment transport, Wind, Wind waves, Wind-driven currents.

A spectral analysis study was constructed to determine if wind-induced currents within the Columbia River estuary were sufficiently large to justify their inclusion in a numerical model of sediment transport within the estuary. The model technique employed a large existing physical hydraulic model of the estuary, a numerical model for wave propagation, a numerical model for sediment transport, and several analytical techniques. Winds and currents were measured and analyzed to help define the relative importance of winds in estuarine processes. Completion of the analysis showed that wind-induced current velocities were considerably less than 0.5 feet per second and consequently have little effect on instantaneous sediment transport. (Halterman-PTT)
W87-09430

LOW FRESHWATER INFLOW STUDY: CHESAPEAKE BAY HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
D. R. Richards, and L. F. Gulbrandsen.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA112215, A09 in paper copy, A01 in microfiche. Technical Report HL-82-3, January 1982. Final Report, 190 p, 14 fig, 4 tab, 115 plates.

Descriptors: *Chesapeake Bay, *Model studies, *Hydraulic models, *Consumptive use, *Saline water intrusion, *Water demand, *Future planning, Bays, Models, Drought, Water shortage, Encroachment, Water resources development, Prediction, Hydrographs.

A study was initiated to predict the impact of consumptive losses on the Chesapeake Bay and future water resource programs prompted by population increases. A physical model was used to compare tide, velocity, and salinity data for a historical period of low flow with data resulting from freshwater inflow suppressed by the consumptive losses that may be expected some 50-60 yr in the future. Known drought hydrographs combined with anticipated consumptive losses and diversions for the future were used to assess the bay's rebound potential following a drought period. Thirty-two stations representative of the bay were analyzed to assess the effectiveness of the study. Results showed a general increase in salinity values in the future condition throughout the bay on the order of 1 to 3 parts per trillion. Little differences in tides and current velocities were noted between tests. Variations in vertical salinity structures between spring and neap tide were observed at some stations in the bay, although in general, there was little change resulting from the consumptive losses. The bay's rebound after drought conditions was assessed at several stations and data showed a return to a state of dynamic normalcy within 3 to 6 mo at all stations analyzed for both tests. (Geiger-PTT)
W87-09484

EXAMINATION OF TIDAL FLATS, VOL. 1: RESEARCH REPORT.
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 4C.
W87-09492

EXAMINATION OF TIDAL FLATS, VOL. 3: EVALUATION METHODOLOGY.
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 4C.
W87-09493

PROCESSES AFFECTING THE DISTRIBUTION OF LOW-MOLECULAR-WEIGHT ALIPHATIC HYDROCARBONS IN COOK INLET, ALASKA,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 5B.
W87-09506

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

LINEAR REGRESSION MODEL COMBINED WITH A SOIL WATER BALANCE MODEL TO DESIGN MICRO-CATCHMENTS FOR WATER HARVESTING IN ARID ZONES,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
T. M. Boers, M. De Graaf, R. A. Feddes, and J. Ben-Asher.
Agricultural Water Management AWMADF, Vol. 11, No. 3/4, p 187-206, September 1986. 12 fig, 3 tab, 16 ref.

Descriptors: *Rainfall-runoff relationships, *Arid zone, *Water harvesting, *Runoff, *Model studies, *Soil water, *Catchment areas, Design criteria, Agriculture, Simulation, Rainfall, Regression analysis, Water balance, Water budget.

In arid zones, where water harvesting techniques can be applied to use surface runoff for agricultural production, long-term meteorological records are often scarce. This is a problem when designing a water harvesting system, for instance, with micro-catchments. This paper presents a design method for micro-catchments, based on a simulation approach. Available rainfall and evaporation data are supplemented with soil physical data, determined from samples taken on the spot. A linear regression model combined with a transient one-dimensional finite difference water balance model is used to simulate the complete water harvesting process for a number of years. The theoretical basis of the model, including initial and boundary conditions is discussed. Experimental data from the Northern Negev Desert are used to calibrate the model. The water balance is simulated for two sets of soil physical properties, and for extremely arid and arid conditions. The performance of micro-catchments with varying runoff area A and basin are B is studied. This A/B ratio is a key parameter in micro-catchment design. The following conclusions are drawn: (1) extremely arid conditions ('true desert') are too dry for micro-catchment-water-harvesting; (2) for arid conditions with average annual rainfall of ca. 200 mm, and the trees and loess soil considered, a preliminary design would have a basin area B of ca. 40 sq m and a runoff area A of between 40 and 80 sq m. (Author's abstract)
W87-08738

SCPP METEOROLOGICAL AND STATISTICAL SUPPORT FOR PERIOD 1 SEPTEMBER 1985, 31 AUGUST 1986, VOLUME I: INTERIM PROGRESS REPORT,
Electronic Techniques, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 2B.
W87-09334

3C. Use Of Water Of Impaired Quality

PROPOSALS FOR AGRICULTURAL DEVELOPMENT OF WADI DHULEIL CATCHMENT, JORDAN,
Agrar-und Hydrotechnik, Essen (Germany, F.R.).
For primary bibliographic entry see Field 3F.
W87-08739

IRRIGATION WITH BRACKISH WATER UNDER DESERT CONDITIONS: IV. SALT TOLERANCE STUDIES WITH LETTUCE (LACTUCA SATIVA L.),
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Applied Research Inst.
D. Pasternak, Y. De Malach, I. Borovic, M. Shram, and C. Aviram.
Agricultural Water Management AWMADF, Vol. 11, No. 3/4, p 303-311, September 1986. 3 fig, 3 tab, 13 ref.

Descriptors: *Irrigation, Brackish water, *Impaired water use, *Deserts, *Salt tolerance, Field tests, Lettuce, Salinity, Crop yield.

In a field trial, three Romaine lettuce cultivars and seven iceberg cultivars were drip irrigated from day 20 after planting with water of four levels of salinity (electrical conductivity of 1.2, 3.5, 8.2 and 10.5 dS/m). The Romaine lettuce cultivars were far more tolerant to salinity than the iceberg cultivars. There were no specific salt-tolerant cultivars within either of the two cultivar groups. The slope of the linear regression of relative yield vs. salinity was -5.6 for the iceberg lettuce cultivars, which is half the value reported elsewhere for lettuce. Iceberg lettuce appears to be more sensitive to salinity at later than at early growth stages. There was no apparent osmotic adaptation of lettuce to salinity. The osmotic potential of the leaves decreased to -1.3 MPa about a month after planting and then gradually increased to -0.6 MPa. (See also W87-08747) (Author's abstract)
W87-08746

IRRIGATION WITH BRACKISH WATER UNDER DESERT CONDITIONS: V. NITROGEN REQUIREMENT OF TOMATOES (LYCOPERSICON ESCULENTUM MILL.) DURING GERMINATION UNDER DRIP IRRIGATION,
D. Pasternak, Y. Zohar, Y. De Malach, I. Borovic, and M. Twersky.
Agricultural Water Management AWMADF, Vol. 11, No. 3/4, p 313-318, September 1986. 5 tab, 9 ref.

Descriptors: *Irrigation, Brackish water, *Impaired water use, *Deserts, *Salt tolerance, Tomatoes, Nitrogen, Nutrients, Leaching, Crop yield.

Daily application of brackish water by drip irrigation during the germination of tomatoes (Lycopersicon esculentum Mill.) resulted in efficient leaching of the major nutrient ions from the area immediately under the emitters. A 2-week delay in the application of nitrogen to the germinating seedlings resulted in severe retardation of their growth and in delayed flowering, regardless of the salt concentration in the irrigation water. The results indicate that, in the desert, when brackish water is used to germinate tomato seedlings with a drip system in a sandy-loam soil, nitrogen should be applied daily with the irrigation water, starting on the 1st day of irrigation. (See also W87-08746) (Author's abstract)
W87-08747

EFFECTS OF DISTILLERY WASTE ON THE PERFORMANCE OF CICER ARIETINUM L.,
Gorakhpur Univ. (India). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W87-08873

SOIL CLOGGING DURING SUBSURFACE WASTEWATER INFILTRATION AS AFFECTED BY EFFLUENT COMPOSITION AND LOADING RATE,
Wisconsin Univ.-Madison. Coll. of Agricultural and Life Sciences.
For primary bibliographic entry see Field 5C.
W87-08928

PERENNIAL PASTURE PRODUCTION AFTER IRRIGATION WITH SALINE GROUNDWATER IN THE GOULBURN VALLEY, VICTORIA,
Department of Agriculture and Rural Affairs, Victoria (Australia). Inst. for Irrigation and Salinity Research.

A. H. Mehanni, and A. P. Repsys.
Australian Journal of Experimental Agriculture AAAHAN, Vol. 26, No. 3, p 319-324, 1986. 4 fig, 5 tab, 14 ref.

Descriptors: *Impaired water use, *Water pollution effects, *Pasture management, *Irrigation water, *Groundwater, *Saline water, *Productivity, *Salinity, *Victoria, Australia, Pastures, Gypsum, Clover, Chemical properties, Chemical composition, Soil chemical properties, Minerals, Saline soils, Soil types, Crop yield, Roots, Irrigation.

Irrigation water with nominal salinities of 100, 300, 700, 1,500, or 3,000 mg/l and superimposed yearly gypsum treatment (5 t/ha) were applied for two years on established white clover, ryegrass, and paspalum pasture grown on a red-brown earth soil type, and for another six years after the pasture was sod-seeded with strawberry clover. Initially, pasture dry matter production decreased at all salinities above the control, predominantly because of a decline in white clover growth. However, after strawberry clover was added to the sward, pasture yield was not significantly affected by water with salinities up to 700 mg/l in any one year, and only reduced by about 25 and 50% at 1,500 and 3,000 mg/l, respectively. Soil salinities had largely reached equilibrium after four years, and relative pasture yields remained relatively stable from then to the end of the experiment; it is not expected to change greatly in the longer term. Pasture mineral composition was within the recommended range for animal diet requirements. (Author's abstract)
W87-09208

STUDY OF SALINE WATER USE AT THE HARRY ALLEN GENERATING STATION,
J. K. Laughlin.
Final Report, Task 4. November 28, 1986. 65 p, 5 fig, 11 tab, 6 ref. Basic Agreement No. 4-AB-81-03600.

Descriptors: *Saline water, *Water use, *Harry Allen Generating Stations, *Nevada, *Colorado River, *Virgin River, Powerplants, Economic aspects, Water supply, Water reuse.

Saline water from the Lower Virgin River was evaluated as a potential water supply to the proposed Harry Allen Generating Station near Las Vegas, Nevada. The Lower Virgin River is under investigation by the Bureau of Reclamation as a potential control source for 20,100 tons of salt that flows annually into the Colorado River system. The objectives of the study included technical and economic evaluation of the in-plant cost differences for water supply using either the Lower Virgin River Unit water or Clark County secondary treated sewage effluent as the sources for the Harry Allen Generating Station. Evaluations of the technical risks for use of Lower Virgin River Unit water vs. secondary sewage effluent showed that the plant design and operating uncertainties were about equal in magnitude if water quality for the sources were predictable. Overall results show that the Lower Virgin River Unit water source is a viable water supply for the Harry Allen Station, provided the quality and quantity of water supply are confirmed by additional wells and monitoring. Cost advantages of the ion exchange/sidestream treatment process can be incorporated into the Harry Allen design if the technical and economic viability of the process can be confirmed through field demonstrations. (Author's abstract)
W87-09332

INDUCTION OF CRASSULACEAN ACID METABOLISM IN MESEMBRYANTHEMUM CRYSTALLINUM BY HIGH SALINITY: MASS INCREASE AND DE NOVO SYNTHESIS OF PEP-CARBOXYLASE,
Botanisches Institut der Universitat Wurzburg, Mittlerer Dallenbergweg, D 8700 Wurzburg, Federal Republic of Germany.
R. Hofner, L. Vazquez-Moreno, K. Winter, H. J. Bohnert, and J. M. Schmitt.
Plant Physiology PLPHAY, Vol. 83, No. 4, p 915-919, April 1987. 3 fig, 1 tab, 21 ref.

Descriptors: *Impaired water use, *Salinity, *Salt tolerance, *Halophytes, *Crassulacean acid, *Enzymes, *Mesembryanthemum, Nutrients, Irrigation, Proteins, Leaves, Salts.

Intact plants of the halophilic species Mesembryanthemum crystallinum were induced to exhibit Crassulacean acid metabolism by irrigation with nutrient solution containing 500 millimolar NaCl. During the induction period, the extractable activity of phosphoenolpyruvate carboxylase (PEPcase) increased approximately 40-fold. This increase was linearly correlated with a mass increase of PEPcase protein as measured by single radial immunodiffusion. De novo synthesis of PEPcase protein was shown by immunoprecipitation of the newly synthesized, radioactively labeled protein in leaf discs from salt-treated plants. Nontreated plants were characterized by a low level of the enzyme and low rates of PEPcase synthesis. Synthesis of this enzyme in leaf discs was correlated with the concentration of NaCl in the nutrient solution during growth. (Author's abstract)
W87-09418

3F. Conservation In Agriculture

SEMIARID SOIL AND WATER CONSERVATION,
Finkel and Finkel, Yoqneam (Israel).
H. J. Finkel.
CRC Press, Inc., Boca Raton, FL. 1986. 126 p.

Descriptors: *Semiarid lands, *Water conservation, *Soil conservation, *Developing countries, Agriculture, Irrigation, Seasonal variation, Temperature, Soil erosion, Precipitation.

Erosion and conservation measures discussed are, for the most part, those under unirrigated agriculture. The use of irrigation could cause significant changes in the growing seasons, and in the agricultural calendar, especially in the warmer climates where temperature is not a limiting factor. It is further noted that much of the material in this volume has been prepared with the developing countries of the so-called Third World in mind. In many of these countries there is a dearth of basic data, such as long-term hydrological records, detailed soil and topographic surveys, and experimental results for various types of erosion control measures. Some design procedures cannot be imitated or copied directly from those of the technologically more advanced countries. Consequently, emphasis will be placed, wherever possible, upon simple empirical methods of design, and approximate solutions within the limitations of the available data, technical possibilities, and financial resources of the Third World countries. Much of the numerical data and calculations are presented in the metric system. (See also W87-08662 through W87-08669) (Lantz-PTT)
W87-08661

AGRONOMIC MEASURES FOR SOIL AND WATER CONSERVATION,
Finkel and Finkel, Yoqneam (Israel).
H. J. Finkel.
IN: Semiarid Soil and Water Conservation, CRC Press, Inc., Boca Raton, FL. 1986. p 39-53, 5 fig, 3 tab, 17 ref.

Descriptors: *Agronomy, *Soil conservation, *Water conservation, *Erosion control, Land use, Tillage, Mulching, Cultivation, Runoff, Semiarid lands.

With the human population explosion and the consequent expansion of agriculture in most parts of the temperate and tropical world, the balance of soil loss and deposition became seriously upset. More ground was tilled, trees and grasses were removed, and the unprotected surface was exposed to the ravages of erosion. With the disappearance of the topsoil and the exposure of the tighter subsoil, infiltration rates were reduced and the depth of moisture stored in the soil profile was lessened. This resulted in greater runoff which, in turn, led to more removal of soil. The erosion process is therefore seen to be progressive, with steadily growing rates of soil loss. Floods became more frequent, alternating with severe droughts. In some regions of the world this process reached the ultimate destruction, and only 'badlands' remained, with gullies cut down to the bedrock. Since the progressive process of accelerated erosion is initiated with the first removal of the natural protective vegetative cover, it is the vegetative methods of control to which man must first turn. Only when these prove inadequate should the more costly engineering, or mechanical measures be introduced. The agronomic measures are, for the most part, such that the farmer himself can put into practice, and include: (1) Land use; (2) Crop selection, rotation, and management; (3) Tillage; (4) Mulching; (5) Contour cultivation; and (6) Contour strip cropping. These methods are discussed in depth. (See also W87-08661) (Lantz-PTT)
W87-08664

PASTURE AND FOREST MANAGEMENT IN THE MEDITERRANEAN UPLANDS,
Technion, Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
Z. Naveh.
IN: Semiarid Soil and Water Conservation, CRC Press, Inc., Boca Raton, FL. 1986. p 55-73, 3 fig, 56 ref.

Descriptors: *Forest management, *Pasture management, *Mediterranean basin, Agronomy, Ecological effects, Ecology, Soil stability, Conservation, Erosion.

There is probably no other region in the world that has endured more long lasting and intensive human impact throughout its history from the Pleistocene until present times, than the Mediterranean Basin. There is also no other region where the unfortunate combination of a vulnerable environment and a long history of man's misuse of the land have caused such far-reaching and severe damage of soil erosion and depletion, landscape desiccation, and what is called now 'desertification'. Nowhere else are the dangers of combined traditional and neotechnological pressures from accelerating populations, tourists, and urban-industrial developments more threatening, causing new menaces of soil and water erosion, flooding, and land destruction. At the same time, however, because of these long lasting and severe human pressures, nowhere else - at least in comparable climatic and ecological conditions - can the striking resilience, regenerative powers, and soil building and protective capacities of the native vegetation be demonstrated better than on the denuded Mediterranean uplands. This paper attempts to point out these features and to show that they can be used as part of conservative, ecologically sound management and improvement practices for the redemption of these uplands, not only for pastoral and silvicultural uses, but also for other multiple, socioeconomic and ecological benefits, and, above all, for upland soil and water conservation. (See also W87-08661) (Lantz-PTT)
W87-08665

ENGINEERING MEASURES: WATERWAYS AND DIVERSION CHANNELS,
Finkel and Finkel, Yoqneam (Israel).
For primary bibliographic entry see Field 8A.
W87-08666

ENGINEERING MEASURES FOR SOIL AND WATER CONSERVATION: TERRACING AND BENCHING,
Finkel and Finkel, Yoqneam (Israel).
H. J. Finkel.
IN: Semiarid Soil and Water Conservation, CRC Press, Inc., Boca Raton, FL. 1986. p 85-91, 5 fig, 16 ref.

Descriptors: *Water conservation, *Soil conservation, *Terracing, *Benching, Land forming, Agriculture, Engineering, Channels, Semiarid lands.

Terracing, as discussed here, refers to the broad-based terrace constructed in the form of a ridge and channel, the entire surface of which is cultivated as part of the field. The ancient system of 'staircase' agriculture, now known as benching, is

treated separately. The first broad-based terraces were developed in the humid eastern part of the U.S. Their purpose is to shorten the length of the slopes for reduction of soil erosion, and to lead off surplus storm water at a safe velocity to a protected outlet, usually a grassed waterway. These terraces have a cross section which is wide and flat enough to permit the use of farm machinery both on the ridge and in the channel. This 'drainage type' terrace is not suitable for semiarid regions, where every effort must be made to retain it on the field,while preventing both local waterlogging and soil erosion. This is accomplished by the 'adsorption type' terrace. The most important absorption type of parallel terrace for the semiarid regions is the flat channel terrace, or, as it is sometimes known, the Zingg conservation bench terrace. There are several variations on the broad-based terrace in addition to the Zingg type, but for semiarid regions where water conservation is of paramount importance, it is recommended that the level, closed type should be used wherever possible. In addition to water conservation, the level, impoundment-type terrace retains more soil than any of the other types. However, when such terraces are installed on an erosive field, the channels will quickly become filled with trapped erosion sediment; consequently, they should be cleaned and maintained regularly. The soil removed from the terrace channel should be returned to the field. Benching, or bench terracing, refers to the practice of converting a sloping field into a series of almost level areas or steps. It has also been called 'staircase farming'. Benching is one of the oldest soil conservation systems in history. The effect of bench terracing on the rate of soil loss is very great. If the benches are almost level, and the intervening walls are made of stone, the soil loss will be practically zero, unless an unusual storm exceeds the capacity of the benches to hold water behind the freeboard of the wall, and overtopping occurs. (See also W87-08661) (Lantz-PTT)
W87-08667

ENGINEERING MEASURES: WATER HARVESTING,
Finkel and Finkel, Yoqneam (Israel).
H. J. Finkel, and M. Finkel.
IN: Semiarid Soil and Water Conservation, CRC Press, Inc., Boca Raton, FL. 1986. p 93-101, 2 fig, 7 ref.

Descriptors: *Water conservation, *Water harvesting, *Irrigation, Agriculture, Water use, Water storage, Dams, Semiarid lands.

Water harvesting is the collection of runoff and its use for the irrigation of crops, pastures, and trees, and for domestic and livestock consumption. Since this definition could cover almost all fields of water resource development, it must be added that the term 'water harvesting' is usually used for the development of marginal waters in arid or semiarid regions. The projects are generally local and of a small scale that do not include the treatment of water or its conveyance over long distances. They may be classified according to the source of the water and the use to which it will be put. The latter has two categories: irrigation and for human and/or animal consumption. In the case of water for consumption, two additional elements must be included: storage and treatment. The storage is needed because the rate of consumption of water will generally be slower than the rate of harvesting. In the case of water for irrigation, the soil itself serves as a reservoir for a certain period of time. For a longer storage period seasonal reservoirs may be required. Dams on intermittent streams to contain flash floods are also considered to be a form of water harvesting. However, this paper deals only with water harvesting techniques for irrigation purposes, and only short-term storage facilities. (See also W87-08661) (Lantz-PTT)
W87-08668

GULLEY CONTROL,
Finkel and Finkel, Yoqneam (Israel).
H. J. Finkel.
IN: Semiarid Soil and Water Conservation, CRC Press, Inc., Boca Raton, FL. 1986. p 103-108, 4 fig, 1 ref.

Descriptors: *Soil conservation, *Erosion control, *Gully erosion, Gullies, Water conservation, Watersheds, Channel erosion, Dams, Channel improvement.

The gully is the most obvious and spectacular form of soil erosion as it causes large, unsightly gashes in the landscape. Deep gullies which spread back to the watershed divide can destroy an entire area and are the ultimate form of soil erosion known as 'badlands'. Not all gullies are so ominous, but they are insidious in their growth potential, and must be brought under control in the earliest possible stages. They appear in several forms, each of which has different characteristics and requires different methods of control. The two principal types are so-called V and U gullies. The V gully is characterized by a V-shaped cross section. It generally appears on sloping field. The longitudinal gradient of the channel is greater than the slope of the land. The erosion is in the form of downward cutting in the center of the channel, causing it to become deeper as well as to grow backward. Because this type of gully forms on the more hilly lands, the distance back to the watershed divide is generally shorter and the catchment area feeding the gully is small. V-shaped gullies often develop from rill erosion, when the water is concentrated from several rills into one channel. The U-type gully is recognized by its U-shaped cross section. The longitudinal slope of the channel bottom is usually parallel to the slope of the land through which it passes. It occurs on land with low slopes, almost approaching zero, and is often a source of surprise to travelers who do not expect to see such serious erosion on broad plains. In such flat topography, the distance back to the watershed divide is relatively long, and the catchment areas are consequently large. The flood discharge passing through the U-type is larger, and the velocity of flow is usually slower than in the V-type. The active erosion of the U-type gully is in the sidewalls and the headwall as a result of undercutting at the base of the vertical cut. The channel does not grow deeper, but becomes wider and grows in length headward. These are logical points of control. The methods employed are quite different from those described for the V-type, and should have the following sequence: (1) raising the datum, (2) reshaping the walls, and (3) stabilizing the channel. (See also W87-08661) (Lantz-PTT)
W87-08669

PROPOSALS FOR AGRICULTURAL DEVELOPMENT OF WADI DHULEIL CATCHMENT, JORDAN,
Agrar-und Hydrotechnik, Essen (Germany, F.R.).
A. F. Bichara.
Agricultural Water Management AWMADF, Vol. 11, No. 3/4, p 207-219, September 1986. 3 fig, 5 tab, 7 ref.

Descriptors: *Water use, *Salinity, *Irrigation effects, *Water resources development, *Irrigable land, *Agriculture, *Wadi Dhuleil, *Catchment areas, Vegetables, Food crops, Aquifers, Groundwater, Salinity, Farming.

Irrigated agriculture started in the Wadi Dhuleil catchment area in the early Sixties and brought about 6000 ha under irrigation. More than 1500 ha of these 6000 are permanently fallow at the moment and about 75% of the remaining 4500 ha are mainly used for the cultivation of vegetables and orchards. This system has led to a drastic overpumping of the aquifer; increasing salinity of the pumped irrigation water as well as a marked drop in the groundwater levels have been observed. Crops are being affected and farmers are slowly being forced to either adopt new and expensive irrigation techniques or simply abandon their lands. If no water-saving measures are implemented very soon, this situation will certainly deteriorate further resulting in a loss to the national economy. In this paper, an attempt is made to quantify this situation by drawing a simplified water and land balance. Proposals for the optimum and safe use of resources are made. (Author's abstract)
W87-08739

ESTIMATING WATER TABLE CONTRIBUTION TO THE WATER SUPPLY OF MAIZE,
Alexandria Univ. (Egypt). Coll. of Agriculture.
R. A. Ragab, and F. Amer.
Agricultural Water Management AWMADF, Vol. 11, No. 3/4, p 221-230, September 1986. 4 fig, 2 tab, 18 ref. Supreme Council of Universities Grant 82010.

Descriptors: *Water resources development, *Irrigation design, *Irrigation, *Corn, *Field tests, *Plant water use, *Water table, *Model studies, Computers, Root zone, Soil water, Crop yield.

An irrigation field experiment with maize (Zea mays L.) was conducted on a non-saline clay loam soil underlain by clay mixed with shells at 40-50 cm depth and a fluctuating shallow water table. Two independent procedures were used to determine water table supply through capillary rise to the crop water requirement. The first involves the development of a computer model based on Darcy's Law for calculating the capillary flux. The model uses, as inputs, the relationship between hydraulic conductivity and water content, the depth of water table below the root zone, and the matric suction at the bottom of the root zone. The second procedure was based on the soil water balance by taking water table contribution as the difference between estimated evapotranspiration (ET) and measured soil water depletion (SWD). Water table contribution was estimated for a 75-day period from 41 days after planting to harvest. The capillary flux computed by the CUF model averaged 0.433 cm/day. Both procedures estimated water table contribution to be in the range of 19-22 cm, which amounts to about 40% of the ET over the 75-day period. Maize yield increased, while SWD tended to increase and water table contribution tended to decrease, as the number of irrigations was increased from 4 to 6. (Author's abstract)
W87-08740

BARE SOIL EVAPORATION NEAR A SURFACE POINT-SOURCE EMITTER,
Arizona Univ., Tucson. Dept. of Soil and Water Science.
For primary bibliographic entry see Field 2D.
W87-08743

SURGE IRRIGATION MANAGEMENT,
Florida Univ., Belle Glade, FL. Everglades Research and Education Center.
F. T. Izuno, and T. H. Podmore.
Agricultural Water Management AWMADF, Vol. 11, No. 3/4, p 279-291, September 1986. 2 fig, 4 tab, 13 ref.

Descriptors: *Flood irrigation, *Furrow irrigation, *Irrigation management, *Surge irrigation, *Model studies, *Infiltration, Field tests, Simulation, Runoff, Computers.

A technique for managing surge irrigations on a particular field to achieve uniform and efficient applications was developed. The method derived uses a kinematic wave computer simulation model and knowledge of infiltration behavior under surge irrigation gained from field studies. For the field conditions used, uniform and efficient surge irrigations could be achieved by considering an irrigation in two parts, the advance and post advance phases. Simulation model results indicated that there appears to be an optimum number of surge cycles to complete the advance phase to irrigate uniformly using a desired volume of water. The optimum number of surges is dependent on the use of the maximum non-erosive inflow stream for the particular field and appropriate cycle on-times. The post advance phase can be conducted using a continuous application at a reduced instantaneous inflow rate. The inflow rate and application time for the post advance phase can be determined such that runoff is minimized. Appropriate cycle times and reduced inflow rates and application times can be determined using the computer model. (Author's abstract)
W87-08744

IMPROVEMENT OF IRRIGATION WATER BY GYPSUM BEDS,
Haryana Agricultural Univ., Hisar (India). Dept. of Soils.
For primary bibliographic entry see Field 5G.
W87-08745

WATER PRODUCTION FUNCTIONS FOR WHEAT UNDER DIFFERENT ENVIRONMENTAL CONDITIONS,
J. N. Agricultural Univ., Madhya Pradesh (India). Coll. of Agriculture.
G. S. Rajput, and J. Singh.
Agricultural Water Management AWMADF, Vol. 11, No. 3/4, p 319-332, September 1986. 2 fig, 6 tab, 16 ref.

Descriptors: *Irrigation management, *Irrigation design, *Irrigation efficiency, *Wheat, *Plant water use, *Evapotranspiration, *Crop yield, Climates, India, Soil types, Field tests.

Water production functions have been developed in numerous forms; however, their transferability to widely different soils and climatic conditions is still a debatable subject. A study was conducted to evaluate the performance of existing evapotranspiration-yield functions for wheat with regard to their applicability and transferability under different environmental conditions in India. The functions were verified with data from field experiments conducted at a number of research stations located in different climatic regions of India. Depending on the nature of data input the functions were grouped into seasonal and growth stage functions. All functions were found to be statistically acceptable with regard to fitting available data. However, regression coefficients, i.e., yield response sensitivity factors varied in magnitude with the location of experiment even for the same wheat variety, which implies that the existing functions are site specific. Further the yield response sensitivity factor for the seasonal function was found to be dependent on site climatic and soil variables. (Author's abstract)
W87-08748

NEW METHOD FOR LINING OF FIELD IRRIGATION CHANNELS,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Agricultural Engineering.
A. Ahmed, and R. C. Yadav.
Agricultural Water Management AWMADF, Vol. 11, No. 3/4, p 343-348, September 1986. 3 fig, 1 tab, 2 ref.

Descriptors: *Irrigation canals, *Linings, Agriculture, Farming, Construction methods, Irrigation.

A simple and little labor-demanding method for in situ lining of field irrigation channels was developed. It needs wooden guides for lining thickness and a channel form. The method was employed to line channels with different materials such as cement sand mortar and laterite at a rate of 1 m per manhour and with natural clay and clay mixed with cow dung at a rate of 0.5-0.7 m per manhour. The method is relatively simple and cheap and the equipment can be fabricated by village carpenters. It is suitable for lining small irrigation channels. Small-scale farmers could line their channels successfully with the help of four laborers. (Alexander-PTT)
W87-08750

USE OF CANOPY TEMPERATURES TO IDENTIFY WATER CONSERVATION IN COTTON GERMPLASM,
Agricultural Research Service, Lubbock, TX. Plant and Water Conservation Research Unit.
J. L. Hatfield, J. E. Quisenberry, and R. E. Dilbeck.
Crop Science CRPSAY, Vol. 27, No. 2, p 269-273, March-April 1987. 3 fig, 4 tab, 15 ref.

Descriptors: *Water conservation, *Cotton, *Water stress, *Agriculture, *Canopy temperatures, Canopy, Soil water, Temperature, Water deficit, Clay loam, Infrared thermometry.

Screening crop germplasm for water conservation traits is difficult under dryland environments because of the variability in soil-water use. Canopy temperatures were related to crop water stress. Whether cotton (Gossypium hirsutum L.) germplasm differs in canopy temperatures and whether these temperatures could be related to performance under deficient soil-water conditions were evaluated. Cotton strains (both exotic and commercial) were grown in irrigated and dryland field plots on an Olton clay loam. The dryland plots were grown under a rainout shelter to exclude any rainfall during the season, while the irrigated plots received two irrigations during the measurement period. Canopy temperatures were measured daily between 1330 to 1430 hours CST with a hand-held infrared thermometer. Consistent canopy temperature differences occurred among strains grown in the irrigated plots even though the environmental conditions varied. In the dryland plots, canopy temperatures showed significant strain-by-day interactions suggesting that some strains use their available soil water faster than other strains. Calculated nonstressed baselines showed that the strains had a constant slope of -2.00 C/kPa and differed only in their intercept. Those strains, which had warmer canopies in the irrigated plots, had the larger biomass in the dryland plots. It is possible to separate cotton germplasm with infrared thermometry. (Author's abstract)
W87-08788

ALLOCATION MODEL FOR IRRIGATION WATER COST: CASE STUDY OF THE NILE VALLEY IN EGYPT,
Cairo Univ. (Egypt). Dept. of Irrigation and Hydraulics.
For primary bibliographic entry see Field 6C.
W87-08968

CONTROL OF FURROW EROSION WITH CROP RESIDUES AND SURGE FLOW IRRIGATION,
Agricultural Research Service, Prosser, WA.
D. E. Miller, J. S. Aarstad, and R. G. Evans.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 421-425, March-April 1987. 5 tab, 10 ref.

Descriptors: *Furrow erosion, *Crop residue, *Surge irrigation, Infiltration, Wheat, Corn, Irrigation, Furrows, Sediments.

Crop residues in irrigation furrows reduce erosion, but also increase infiltration rates. High infiltration rates decrease uniformity of irrigation along a furrow. Surge flow improves irrigation uniformity during furrow-stream advance because the stream advances at about the same rate as with continuous flow, but requires only about one-half as much water to reach the end of a furrow. Experiments were conducted to evaluate the combined effects of wheat (Triticum aestivum L.) and corn (Zea mays L.) residues and surge flow irrigation on furrow erosion and irrigation uniformity. Larger than normal furrow streams (up to 30 L/min) were used with surge flow to obtain rapid stream advance. Sediment discharge with such large streams was reduced from > 100 Mg/ha/d from bare furrows to about 1 Mg/ha/d from furrows containing 2 Mg/ha of residue. Differences in erosion between surged and continuous furrow streams were small compared to those due to residues in the furrows. Residues grown in place were more effective in reducing erosion than were residues hand-placed in clean furrows. (Author's abstract)
W87-09003

SOIL WATER EVAPORATION COMPARISONS AMONG TILLAGE PRACTICES IN THE NORTHERN GREAT PLAINS,
Agricultural Research Service, Sidney, MT.
For primary bibliographic entry see Field 2D.
W87-09006

SMALL-SCALE SURFACE (TANK) IRRIGATION IN ASIA,
International Rice Research Inst., Los Banos, Laguna (Philippines). Agricultural Engineering Dept.
K. Palanisami, and K. W. Easter.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 774-780, May 1987. 3 tab, 13 ref.

Descriptors: *Tank irrigation, *Irrigation systems, *India, Asia, Farming, Agriculture, Financing.

Tank irrigation is an ancient tradition in Asia which in now being reviewed as a potential model for future irrigation expansion. South India has thousands of tanks which are in need of rehabilitation after being in operation for over a century. This study evaluates tank irrigation in an area of south India which has the greatest concentration of tanks. Constraints and unique characteristics of tank irrigation are analyzed to provide a basis for devising strategies for improving tank irrigation. A combination of public and private investments along with institutional changes are recommended to help farmers organize to improve irrigation. Yet, only if public investment is carefully integrated with existing private efforts will farmers have incentives to maintain the irrigation systems. (Author's abstract)
W87-09015

SYNTHESIS OF A SIMPLIFIED WATER USE SIMULATION MODEL FOR PREDICTING WHEAT YIELDS,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soils.
For primary bibliographic entry see Field 2I.
W87-09028

CHANGES AT PANICLE EMERGENCE IN THE WATER RELATIONS OF A WETLAND AND A DRYLAND JAPONICA RICE CULTIVAR UNDER WETLAND CONDITIONS,
Hokuriku National Agricultural Experiment Station, Inada, Joetsu-shi, Niigata-ken, 943-01, Japan.
For primary bibliographic entry see Field 2I.
W87-09415

YIELD REDUCTIONS IN WINTER BARLEY GROWN ON A RANGE OF SOILS AND EXPOSED TO SIMULATED ACID RAIN,
Inst. of Terrestrial Ecology, Bangor Research Station, Penrhos Road, Bangor Gwynedd LL57 2LQ, North Wales, UK.
For primary bibliographic entry see Field 5C.
W87-09416

ADVANCES IN IRRIGATION, VOLUME 3,
Massachusetts Univ., Amherst. Dept. of Plant and Soil Sciences.
Academic Press, Orlando, FL, 1985. 323 p. Edited by Daniel Hillel.

Descriptors: *Irrigation practices, *Irrigation programs, *Irrigation, *Trickle irrigation, *Evapotranspiration, Model studies, Models, Simulation analysis, Water stress, Developing countries, Soil water.

This volume is the third of a serial publication begun in 1982 designed to provide a forum for periodically updated state-of-the-art reviews of topics related to the rapidly advancing theory and practice of irrigation. This volume includes a variety of topics which are presented in six articles. The first article describes a traveling trickle irrigation system. This linear-move system offers several important advantages over the alternative stationary or rotary trickle systems. In the second article, the development of supplementary irrigation practices in the Southeastern United States is described. The third article introduces a radically new approach to the science and art of monitoring soil moisture called time-domain reflectometry. The fourth article presents a comprehensive and sweeping view and review of India's irrigated agriculture, its problems and prospects. The fifth article is a critical survey and analysis of the task of estimating evapotranspiration. The final article describes a simulation model for predicting the effect of water stress on yields, and applies this model to the particular case of growing corn under moisture-limiting conditions. (See also W87-09465 thru W87-09470) (Geiger-PTT)

W87-09464

TRAVELING TRICKLE IRRIGATION SYSTEM,
Agricultural Research Service, Fresno, CA. Water Management Research Lab.
C. J. Phene, T. A. Howell, and M. D. Sikorski.
IN: Advances in Irrigation, Volume 3. Academic Press, Orlando, Florida, 1985. p 1-49, 30 fig, 2 tab, 54 ref.

Descriptors: *Trickle irrigation, *Irrigation practices, *Irrigation efficiency, *Irrigation engineering, *Irrigation, Water use efficiency, Crop production, Irrigation programs, Soil water, Mulching, Irrigation design, Spray Irrigation.

The Traveling Trickle Irrigation System (TTIS) was designed to minimize the limitations of the center pivot system and trickle irrigation systems, and apply water uniformly, independent of environmental variables. Water is delivered to the TTIS via a concrete-lined ditch perpendicular to the irrigation system. A laser guidance control system regulates the speed of the sprinkler movement. Evaluations of the water application system were made using seven different systems which were tested on cotton plants. The water use efficiency of cotton was improved by using below-canopy and overhead spray systems. An evaluation of the photovoltaic system showed the energy conversion efficiency of the system before and after cleaning of the module. The monitoring and feedback systems of the TTIS include devices for the measuring of soil water potential and plant water potential for irrigation scheduling. Vertical mulching or the development of microbasins (furrow diking) is recommended to increase the efficiency of TTIS irrigation. The advantages and disadvantages of the TTIS are discussed. Future research and development needs of the TTIS include advances in laser optics, new low pressure water applicator devices, better feedback systems (soil, water and crop), cultivation practices, and pesticide application techniques. (See also W87-09464) (Geiger-PTT)
W87-09465

IRRIGATION PRACTICE FOR CROP CULTURE IN THE SOUTHEASTERN UNITED STATES,
Agricultural Research Service, Watkinsville, GA.
R. R. Bruce, A. W. Thomas, V. L. Quisenberry, H. D. Scott, and W. M. Snyder.
IN: Advances in Irrigation, Volume 3. Academic Press, Orlando, Florida, 1985. p 51-106, 18 fig, 15 tab, 51 ref.

Descriptors: *Irrigation practices, *Crop production, *Irrigation efficiency, *Irrigation ditches, *Irrigation, Water use efficiency, Irrigation programs, Soil water, Evapotranspiration, Irrigation engineering, Irrigation design, Aquifers, Irrigation wells, Irrigation requirements.

The characteristics of the soils, climate, and water resources that are critical to the realization of the potential benefits from irrigation in the southeastern United states are described. The soils of this area are classified chiefly as Udalfs and Udults and exist in the udic moisture regime and the thermic temperature regime. Average annual rainfall for much of the southeastern United States is about 1250 mm. The increased use of irrigation in the southeastern United States represents a body of economic decisions based on the premise that past rainfall patterns will repeat in the future. A form-free method was used in analyses of rainfall recorded at Watkinsville, Georgia, and Stuttgart, Arkansas. Results of the analyses emphasized that in the face of future risk and uncertainty, simulation provides a means for quantifying expected rainfall over a given planning period. The water resources in Georgia are found in small farm ponds north of the fall line, and in irrigation pits which tap shallow groundwater aquifers. Soil characteristics relevant to irrigation practices are considered. Applicable evapotranspiration data are needed in assessing seasonal irrigation water needs, irrigation equipment design, and selection for a particular farm situation. Integration of the practice of irrigation into crop management schemes require a thorough reexamination of all factors impacting the crop from planting to harvest. The irrigation response of selected crops (corn, cotton, peanuts, snap beans, and soybeans) are examined. (See also W87-09464) (Geiger-PTT)
W87-09466

TIME-DOMAIN REFLECTOMETRY (TDR) AND ITS APPLICATION TO IRRIGATION SCHEDULING,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
G. C. Topp, and J. L. Davis.
IN: Advances in Irrigation, Volume 3. Academic Press, Orlando, Florida, 1985. p 107-127, 9 fig, 21 ref.

Descriptors: *Irrigation requirements, *Irrigation, *Irrigation efficiency, *Irrigation practices, *Irrigation programs, Water use efficiency, Soil water, Irrigation engineering, Irrigation design, Monitoring, Soil moisture meters, Soil properties.

Soil-based measurements of water content are generally needed for irrigation scheduling, however, the same method is rarely used to control the turn-on and turn-off decisions. Time-domain reflectometry (TDR) may be used to control both decisions because it gives a precise and immediate determination of soil water content in the field with an accuracy of 2%. As a result of the strong dependence of the dielectric constant on water only, there is no need to calibrate the TDR for different soils. A representative site for a TDR installation can be chosen using a TDR hand probe. The TDR soil transmission line configuration may be chosen to meet specific requirements and site limitations. The choice of length and orientation of transmission lines allows the use of TDR for setting the full and refill points as well as for monitoring and control of the irrigation system and for controlling the leaching requirements. The TDR instrument consists of four major sections: the timing control unit, the pulser, the receiver, and the data display. A single measurement spanning the depth of the root zone shows immediately the amount of water remaining. The feasibility of TDR for measuring soil salinity and depth to frost layer has also been demonstrated. (See also W87-09464) (Geiger-PTT)
W87-09467

IRRIGATION IN INDIA: A PHYSIOLOGICAL AND PHENOLOGICAL APPROACH TO WATER MANAGEMENT IN GRAIN CROPS,
Indian Agricultural Research Inst., New Delhi. Water Technology Center.
S. K. Sinha, P. K. Aggarwal, and R. Khanna-Chopra.
IN: Advances in Irrigation, Volume 3. Academic Press, Orlando, Florida, 1985. p 129-212, 31 fig, 26 tab, 39 ref.

Descriptors: *India, *Irrigation practices, *Developing countries, *Irrigation efficiency, *Grain crops, Crop production, Crop yield, Irrigation requirements, Irrigation programs, Water management.

Irrigation has been practiced in India since ancient times. A major change required in irrigation development in India is to make it an instrument of high production rather than mere protection, as it has been until recently. The Indian Council of Agricultural Research is responsible for developing appropriate recommendations for crop management and production, including irrigation scheduling. The effect of irrigation on crop yield was studied in wheat, rice, sorghum, and other cereals, pulses and oilseeds. In general, the irrigation projects in areas where rainfall is 1000 mm annually or more have poor performance. In drier regions where total rainfall is between 500 and 700 mm annually, irrigation has been successful. Water for the recommended number of irrigation projects, based on the experiments conducted at Research Farms, is not available for many crops in farmers fields. In regions where adequate provision for water has been made, other inputs are not available in required amounts. The effects of irrigation might be further improved if the appropriate stage for irrigation and fertilizer application could both be used. To meet increased food demands by the year 2000, better management of the existing water resources and greater input of fertilizers, pesticides, and improved seeds will be required. (See also W87-09464) (Geiger-PTT)
W87-09468

ESTIMATING EVAPOTRANSPIRATION,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 2D.
W87-09469

SIMULATION MODEL FOR PREDICTING EFFECT OF WATER STRESS ON YIELD: AN EXAMPLE USING CORN,
Washington State Univ., Pullman. Coll. of Agriculture Research Center.
C. Stockle, and G. Campbell.
IN: Advances in Irrigation, Volume 3. Academic Press, Orlando, Florida, 1985. p 283-311, 4 fig, 3 tab, 40 ref, 2 append.

Descriptors: *Corn, *Water stress, *Models, *Crop yield, *Simulation analysis, Grain crops, Evapotranspiration, Soil water, Plant growth, Water use efficiency, Computer models, Model studies, Mathematical models, Crop production.

The objective is to describe and present some results of a model simulating water stress effects on corn (Zea mays) yield. The model was written in BASIC, but a Pascal version is also available. The model deals only with water and carbon budgets of a corn crop and consists only of a simulation of water transport in the soil-plant-atmosphere system, linked with photosynthesis and growth simulations. The soil water balance is obtained by a finite difference solution of the differential equation describing water flow and storage in the soil. Water uptake by the plant is assumed equal to plant water loss. The amount of water lost to the atmosphere is regulated by an interaction between atmospheric demand, soil water potential, and leaf water potential, this last factor determining finally the stomatal resistance. The atmospheric demand is separated into transpiration and evaporation, according to leaf area index development and canopy structure. To calibrate the model, the soil water depletion, leaf area index, and dry matter production were simulated for the experimental plots of Acevedo at Davis, California. Results showed that important environmental and physiological processes involved in the response of corn yield to water stress are properly included in the model, thereby allowing reasonably good predictions of grain yield for different years and locations. (See also W87-09464) (Geiger-PTT)
W87-09470

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

OPTIMIZATION OF CLOSURE OPERATIONS IN A TIDAL BASIN DURING A STORM-SURGE,
Osservatorio Geofisico Sperimentale, Trieste (Italy).
R. Mosetti.
Applied Mathematical Modelling AMMODL, Vol. 11, No. 1, p 19-22, February 1987. 6 fig, 1 tab, 6 ref.

Descriptors: *Flood control, *Flood protection, *Storm surges, *Optimization, *Closure, *Tidal basins, Mathematical equations, Basins, Control, Coastal waters.

An optimization theory based upon the maximum principle has been used to study the problem of minimizing the time intervals for which a tidal

basin is kept closed during a storm-surge. Although the equations describing the dynamics of the basin have been simplified, interesting results have been obtained showing the advantages of control of storm-surge events. In particular, a reduction in the closure time of up to 50% has been obtained in some cases. (Author's abstract)
W87-08610

EFFECT OF UPLAND PASTURE IMPROVEMENT ON NUTRIENT RELEASE IN FLOWS FROM A 'NATURAL' LYSIMETER AND A FIELD DRAIN,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 5G.
W87-08741

NEW PROCEDURES FOR FLOOD ESTIMATION IN NORWAY,
Norwegian Water Resources and Energy Administration, Oslo (Norway).
For primary bibliographic entry see Field 2E.
W87-08811

WATER QUALITY BENEATH URBAN RUNOFF WATER MANAGEMENT BASINS,
Agricultural Research Service, Fresno, CA. Water Management Research Lab.
For primary bibliographic entry see Field 2F.
W87-08967

RIPARIAN AREAS AS FILTERS FOR AGRICULTURAL SEDIMENT,
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
J. R. Cooper, J. W. Gilliam, R. B. Daniels, and W. P. Robarge.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 416-420, March-April 1987. 2 fig, 7 tab, 17 ref.

Descriptors: *Riparian land, *Agricultural sediments, *Filters, *Watersheds, Cultivation, Agriculture, Cesium isotopes, Flood plains.

Riparian buffer areas are known to trap sediment leaving agricultural fields, but little quantitative data on this process are available. This study was initiated to determine the amount of sediment deposited in riparian areas of two watersheds during the last 20 yr. These watersheds contained approximately 800 and 1400 ha, and about half of each watershed was cultivated land. The areal extent and thickness of the sediment were mapped and described using 137Cs data and sediment-soil morphology. At the field-forest edge 15 to 50 cm of 137Cs sediment accumulated while <5 cm of 137Cs sediment was deposited in the flood plain swamp downstream. Although only a thin (< or = 5 cm) layer of sediment accumulated in the flood plain swamp, the large area available made this an important depositional area. The full potential of the flood plain swamp for sediment deposition has not been utilized. About 80% of the 137Cs sediment measured in the watershed was deposited within 100 m of the exit location from the cultivated fields. Sand dominated the deposition at the forest edge while high silt and clay contents occurred in the flood plain swamp. Sediment delivery estimates for Coastal Plain watershed indicated that 84 to 90% of the sediment removed from the cultivated fields remained in the watershed. It is concluded that riparian areas serve a valuable function by trapping sediment from agricultural fields. (Author's abstract)
W87-09002

ECONOMIC DIFFERENCES BETWEEN CUMULATIVE AND EPISODIC REDUCTION OF SEDIMENT FROM CROPLAND,
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
For primary bibliographic entry see Field 2J.
W87-09090

INTRODUCTION TO URBAN HYDROLOGY AND STORMWATER MANAGMENT,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 4C.
W87-09097

AGRICULTURAL DRAINAGE PRACTICES IN IRELAND,
Foras Taluntais, Ballinrobe (Ireland).
T. D. Ryan.
Environmental Geology and Water Sciences EGWSEI, Vol. 9, No. 1, p 31-40, 1987. 10 fig, 2 tab, 16 ref.

Descriptors: *Drainage practices, *Agriculture, *Ireland, *Reviews, *Cost-benefit analysis, *Conservation, Pipes, Trenches, Water transport, Fish conservation, Wildlife conservation, Hydraulic design, Channels, Weirs, Flow measurement, Flow characteristics, Hydraulics, Waterlogging.

Agricultural drainage practices are reviewed under two main headings: arterial drainage of river catchments by developing main channels, and field drainage of smaller parcels of land using pipes and open trenches. The use of cost-benefit analysis on the arterial drainage program is considered and the inherent errors are discussed. Conservation of the environment is described as it applies to landscaping, fisheries, and wildlife, and the drainage authorities are shown to have an enlightened attitude to proper preservation of the environment. (Author's abstract)
W87-09202

COMPARATIVE STUDY ON THE INTRINSIC RATES OF INCREASE OF CYRTOBAGOUS SINGULARIS AND C. SALVINIAE ON THE WATER WEED SALVINIA MOLESTA,
Expand CSIRO, Indooroopilly (Australia). Long Pocket Labs.
D. P. A. Sands, M. Schotz, and A. S. Bourne.
Entomologia Experimentalis et Applicata ETEAAT, Vol. 42, No. 3, p 231-237, December 1986. 1 fig, 4 tab, 19 ref.

Descriptors: *Biological control, *Life cycles, *Weed control, Aquatic weeds, Insects.

Two weevils, Cyrtobagous salviniae and C. singularis, have potential in the biological control of the aquatic weed Salvinia molesta. This study determined differences in the intrinsic rate of increase of the two weevils and provides a basis for modeling weevil populations in the field. The comparison of the two species on plants of S. molesta rich in nitrogen was intended to reveal any physiological differences that might contribute to their failure or success as biological control agents. The intrinsic rates of increase were determined in the laboratory at 23, 27 and 31 C. Variation in oviposition and immature survivorship accounted for most of the differences between species in r sub m values (exponential growth of a stable-age population in a non-limiting environment). Values for r sub m were higher for C. salviniae (0.210, 0.366, 0.404) than for C. singularis (0.148, 0.140, 0.064) at the 3 temperatures, respectively. At all temperatures, C. salviniae laid seven times more eggs than C. singularis while at 31 C oviposition was reduced for both species by 45%, and was accompanied by a reduction in egg hatch. Oviposition by C. salviniae was almost continuous (92% of weeks with some eggs laid) whereas oviposition by C. singularis was intermittent (50% of weeks) with intervals averaging two weeks without oviposition. Nitrogen concentration in S. molesta affected reproduction by C. singularis more than C. salviniae, an increase of 0.1% (dry wt) increasing weekly oviposition by 7.0% and 3.6% respectively. It is concluded that differences in reproductive physiology, larval and pupal survivorship, and feeding behavior are the major factors in explaining why C salviniae is more effective than C. singularis as a biological control agent for S. molesta. (Author's abstract)
W87-09217

BIOLOGICAL CONTROL OF AQUATIC WEEDS: THE EFFICACY OF HYBRID GRASS CARP IN TWO SOUTHERN CALIFORNIA IRRIGATION CANALS,
Water and Power Resources Service, Denver, CO. Engineering and Research Center.
J. S. Thullen, F. L. Nibling, and J. E. Boutwell.
Report REC-ERC-85-4, September 1985. 56 p, 40 fig, 7 tab, 29 ref.

Descriptors: *Aquatic weed control, *Biocontrol, *Carp, *Irrigation canals, *Macrophytes, Weed control, Aquatic weeds, Aquatic plants, Fish, Biomass, Sago pondweed.

The use of hybrid grass carp (a result of crossbreeding female grass carp, Ctenopharyngodon idella, with male bighead carp, Aristichthys nobilis) for aquatic weed control in irrigation canals was evaluated in a 3-yr cooperative study. Studies were conducted in both a small lateral and a large delivery canal in southern California. Data were collected on macrophyte distribution, biomass, stem length and density, tuber density, and soil composition. During the 1980 growing season, field techniques were developed and baseline measurements were made. Hybrids were stocked from June to September 1981, at rates from 56 to 296 kilograms per hectare. During the summer of 1982, all test sections showed trends of lower plant biomass in stocked areas than in corresponding control areas. An increase in aquatic weed biomass was observed in one test section in the fall of 1982. This indicated a suboptimal stocking rate. The principal aquatic weeds controlled were hydrilla (Hydrilla verticillata), sago pondweed (Potamogeton pectinatus), and curlyleaf pondweed (Potamogeton crispus). The control of Eurasian watermilfoil (Myriophyllum spicatum) by hybrids was inclusive. (Author's abstract)
W87-09480

EVALUATION OF THE MODEL CE-QUAL-R1 FOR USE BY THE AQUATIC PLANT CONTROL RESEARCH PROGRAM,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W87-09486

HYDROGEOLOGICAL PROBLEMS AFFECTING THE EXPLOITATION OF THE PEAT BOG AT PADUL (GRANAD, SPAIN). PRELIMINARY STUDY (PROBLEMAS HIDROGEOLOGICOS QUE AFECTAN A LA EXPLOTACION DE LA TURBERA DE PADUL (GRANAD, ESPANA). ESTUDIO PRELIMINAR),
Universidad de Granada (Spain). Dept. of Hydrogeology.
R. Fernandez-Rubio, and A. Pulido-Bosch.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 125-132, 2 fig, 14 ref.

Descriptors: *Peat bogs, *Geohydrology, *Hydrologic data collections, *Drainage engineering, Groundwater movement, Drainage canals, Subsidence, Drainage programs, Water resources development, Drainage ditches, Drainage patterns, Groundwater management.

The hydrogeological behavior of the peat bog of Padul and its borders is described. A hydrologic map of the bog and its drainage patterns is given. The problems affecting the exploitation of the bog and alternative solutions to these problems are discussed. Hydrogeological studies are in progress try to find the most effective solutions for the resource management problems of the bog. (See also W87-09568) (Geiger-PTT)
W87-09576

4B. Groundwater Management

HYDRAULIC/CHEMICAL CHANGES DURING GROUND-WATER RECHARGE BY INJECTION,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W87-08751

ARTIFICIAL GROUND WATER RECHARGE BY FLOODING DURING GRAPEVINE DORMANCY,
Univ. of California, Davis. Dept. of Viticulture and Enology.
For primary bibliographic entry see Field 2F.
W87-08979

CONGRESSIONAL INITIATIVES,
Senate, Washington, DC.
For primary bibliographic entry see Field 5G.
W87-09133

GROUNDWATER RESOURCE DEVELOPMENT,
For primary bibliographic entry see Field 6D.
W87-09148

GROUNDWATER MANAGEMENT IN FRANCE,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
For primary bibliographic entry see Field 2F.
W87-09205

ROLE OF HYDROGEOLOGY IN COAL MINING NEAR CHANDRAPUR IN MAHARASHTRA, INDIA,
Central Ground Water Board, Maharashtra (India). Central Region.
For primary bibliographic entry see Field 2F.
W87-09569

MINE DRAINAGE PROBLEMS IN INDIAN COALFIELDS, WITH SPECIAL REFERENCE TO THE PROBLEMS IN JHARIA COALFIELD,
Indian School of Mines, Bihar (India). Dept. of Mining Engineering.
For primary bibliographic entry see Field 4C.
W87-09571

EXPLOITATION AND CONTROL OF KARST WATER IN COAL MEASURES,
China National Mining Committee, Peking (China).
For primary bibliographic entry see Field 2F.
W87-09575

PROPOSED HYDROGEOLOGICAL MODEL FOR FUTURE LIGNITE MINING AND GROUNDWATER DRAINAGE IN THE HULA BASIN, NORTHERN ISRAEL,
Geological Survey of Israel, Jerusalem. Hydrogeological Div.
For primary bibliographic entry see Field 2F.
W87-09578

PRELIMINARY HYDROGEOLOGICAL STUDY OF THE REOCIN MINE (SANTANDER, SPAIN) (ESTUDIO HIDROGEOLOGICO PRELIMINAR DE LA MINA DE REOCIN (SANTANDER, ESPANA)),
For primary bibliographic entry see Field 2F.
W87-09579

PROTECTION OF THE KARSTIC SPRINGS SYSTEM IN GOLUBINKA AGAINST CONTAMINATION BY THE SEA WATER (LA PROTECTION DU SYSTEME DES SOURCES KARSTIQUES DE GOLUBINKA CONTRE LA CONTAMINATION PAR LA MER),
Elektroprojekt, Zagreb (Yugoslavia).
B. Pavlin, and F. Fritz.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 227-235, 1 fig, 5 ref.

Descriptors: *Groundwater management, *Karst, *Water quality control, *Saline water intrusion, *Structural engineering, Geohydrology, Karst hydrology, Geological surveys, Water quality management, Springs.

Golubinka Karst spring which is located at the middle part of the Yugoslav coastline has been protected by hydraulic engineering structures against saline water influences which were notable during the dry summer season when the availability of potable water was particularly important. The engineering solution found for this problem was based on geologic, hydrogeologic and morphogenetic analyses and exploratory works helped by speleologic surveying of the spring branches performed by expert divers. (See also W87-09568) (Author's abstract)
W87-09582

GROUNDWATER CONTROL IN OPENCAST MINING OF A LIGNITE DEPOSIT IN SOUTHERN GREECE,
Public Power Corporation Administration of Mines, Athens (Greece).
G. Spiliotis.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 237-250, 6 fig, 6 ref.

Descriptors: *Drainage engineering, *Mining engineering, *Groundwater management, *Project planning, *Pump wells, *Mine drainage, Aquifers, Karst, Geohydrology, Pumpage, Cost analysis, Groundwater movement, Pumping tests, Pumping.

Methods adopted for the protection of the northern part of the Megalopolis lignite mine against inundation by groundwater inflow are described. Groundwater is confined in a karstic aquifer below the floor of the opencast mine. Plans for the groundwater control system include a line of 8 pumpwells with a total pumping capacity of 800 cu m/hr for the protection of the southern part of the mining field. Alongside the northeastern boundaries of the field, a second line of 8 larger pumpwells is planned with a total pumping capacity of 7200 cu m/hr. Depending upon the results of these pumping tests, two supplementary pumping groups with a total pumping capacity of 1200 cu m/hr may be provided within the opencast area to secure the required drawdown under the floor of the mine at all points. Mounted sump pumps are also used to cope with drainage waters and safeguard against flooding of the mine by groundwater. A cost analysis of the proposed pumping system is given. (See also W87-09568) (Geiger-PTT)
W87-09583

MINE AND OPEN PIT DEWATERING AT CHINGOLA, ZAMBIA,
Nchanga Consolidated Copper Mines Limited, Chingola (Zambia). Geology Dept.
T. W. Stalker, and P. C. Schiannini.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 251-272, 6 fig, 2 ref.

Descriptors: *Dewatering, *Drainage engineering, *Pumping, *Mine drainage, *Mining engineering, *Groundwater management, Aquifers, Groundwater movement, Geohydrology, Subsurface drainage, Drainage, Water table, Monitoring, Boreholes, Surface drainage.

In the Nchanga Open Pit copper mine, Zambia dewatering is essential to ensure that groundwater does not hinder earthmoving and adversely affect slope stability. Underground diamond drilling is the most extensively used method for draining the aquifers. Water table monitoring is carried out to plan future pumping arrangements. Where water under pressure is encountered, the area is either cemented before mining is resumed or water control precautions are taken before blasting. Individual borehole flows are measured by direct volumetric methods and the main drains by flowmeters and water traps. The measurements are used to compile a monthly water balance chart and provide a detailed history of dewatering which can be used to predict future water arisings and locate the major sources of groundwater for water control in the event of a major power failure. Measures taken to minimize surface recharge include the building of waste dumps over the caving area, and the excavation of surface drains. Attempts to intercept flows from a series of roughly parallel synclines in the Upper Banded Shale to the east of the underground mine have been made by mining directly into the structures. Other courses of action include increasing the efficiency of pumping from the sump. Future works may involve the sealing of future sumps. (See also W87-09568) (Geiger-PTT)
W87-09584

ORIGIN AND DYNAMICS OF THE WATERS FLOWING INTO THE MINING WORKS IN REOCIN (SANTANDER, SPAIN) (SOBRE EL ORIGEN Y DINAMICA DE LAS AGUAS FLUYENTES A LAS EXPLOTACIONES MINERAS DE REOCIN (SANTANDER, ESPANA)),
Universidad Autonoma de Barcelona, Barcelona (Spain). Dept. de Geodinamica Externa e Hidrogeologia.
For primary bibliographic entry see Field 2F.
W87-09586

INFLUENCE OF UNDERGROUND CONSTRUCTIONS IN CRYSTALLINE ROCK ON GROUNDWATER CONDITIONS AND THE USE OF ARTIFICIAL RECHARGE TO RESTORE A LOWERED PIEZOMETRIC SURFACE,
Chalmers Univ. of Tech., Goteborg (Sweden). Dept. of Water Supply and Sewerage.
A.-C. Anderson, G. Bergman, and L. Carlsson.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 347-357, 7 fig, 10 ref.

Descriptors: *Groundwater management, *Artificial recharge, *Tunnel construction, *Subsurface drainage, *Piezometric head, Tunneling, Tunnel hydraulics, Tunnels, Groundwater movement, Aquifers, Boreholes, Groundwater recharge, Grouting, Case studies.

During underground construction in Sweden, the restoration of the piezometric head and the prevention of lowering and subsidence is handled through artificial recharge. Recharge to restore a lowered piezometric surface is accomplished through wells in the thin layer of frictional material on the bedrock, and through boreholes from the tunnel into the fissured top zone of the bedrock. Artificial recharge into confined aquifers in soil takes place through wells. Artificial recharge through rock requires packers specially adapted to suit each particular recharge hole. Careful management is required to prevent clogging of the recharge well and aquifer. Three case studies each involving the construction of a tunnel in the center of Gothenburg, on the outskirts of Gothnburg, and in Stockholm are presented to demonstrate the use of artificial recharge in underground construction in Sweden. (See also W87-09568) (Geiger-PTT)
W87-09589

HIGH PRESSURE GROUTING IN DEEP GOLD MINES,
Rodio (South Africa) (Pty) Ltd., P.O. Box 524 Isandovale (Tvl) 1600 Republic of South Africa.
H. L. E. Du Bois.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 391-407, 4 fig.

Descriptors: *Grouting, *Mining engineering, *Cements, Portland cements, Slime, Bentonite, Sealants, Binders.

Deep mines below the ground water table make an extensive use of grouting. Caution must be taken when drilling through water-bearing fissues; grouting is usually done at very high pressures. The cost of grouting is a constant concern. Mechanized and partly automated plants feeding the grout underground by long pipes, and the addition of cheap fillers to the grout have contributed to lowering the costs of grouting operations. The use of portland cement alone and mixed with blast furnace cement or slag as a binder is described. The compressive strength of various binders and grouts are compared. Cost considerations and choice of additives and grout are discussed. (See also W87-09568) (Geiger-PTT)
W87-09592

BRITISH EXAMPLES OF A HYDROGEOLOGICAL APPROACH TO THE EVALUATION OF DRAINAGE PROBLEMS IN SUBSURFACE ENGINEERING,
Institute of Geological Sciences, London (England).
For primary bibliographic entry see Field 2F.
W87-09593

PROBLEMS OF WATER INRUSH INTO GREEK UNDERGROUND MINES WITH SPECIAL EMPHASIS TO SEA WATER INRUSH THROUGH KARSTIC LIMESTONES OR IMPERMEABLE FORMATIONS,
Athens Univ. (Greece).
For primary bibliographic entry see Field 2F.
W87-09596

SOME HYDROGEOLOGICAL SOLUTIONS TO THE EXPLOITATION OF UNDERGROUND LIGNITE MINES (QUELQUES SOLUTIONS HYDROGEOLOGIQUES DANS LA CONSTRUCTION DES MINES DE LIGNITE SOUTERRAINES),
M. Matura, J. Mosna, and J. Koza.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 477-499, 11 fig, 1 tab, 6 ref.

Descriptors: *Drainage engineering, *Subsurface drainage, *Groundwater management, *Mine drainage, *Mining engineering, *Drainage engineering, Boreholes, Drainage systems, Drainage practices, Geohydrology, Lignite.

Lignite mining from deposits in South Moravia is conditioned by an efficient preliminary drainage system which can be achieved by several methods. Drainage by means of boreholes dirlled from the surface and in the proximity of the development workings has proven competent; after the development of the working field, the combination by means of boreholes drilled from the underground workings is continued. A method making use of four multidemsional spaces for vectorial representation of the hydrogeological quantities is described. Determination of the center of gravity of the saturated portions of the mining field is less common, but still provides a simple method of successive determination of centers of gravity in the drainage of the mining openings. (See also W87-09568) (Author's abstract)
W87-09597

SPECIAL TECHNIQUES OF GROUND TREATMENT IN MINING WORKS (LAS TECNICAS ESPECIALES DE TRATAMIENTO DEL TERRENO EN LOS TRABAJOS DE MINERIA),
Cimentaciones Especiales, S.A. Procedimientos RODIO-Madrid-Espana.
F. Muzas, and J. L. Velilla.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 501-510, 4 fig.

Descriptors: *Cements, *Soil sealants, *Mining engineering, *Mine drainage, *Mine wastes, Fate of pollutants, Membranes, Groundwater management, Soil treatment, Case studies, Soil stability, Permeability, Groundwater pollution.

The presence of water causes various problems in mining and other underground works and a range of solutions is available applying different specialized soil treatment techniques. The different problems that can occur in access work during operation and in the dumping of deads and wastes are described and classified into problems of stability, impermeability, and environmental contamination. The various specialized soil treatments applicable are reviewed and illustrated with actual examples from mining jobs and other types of underground work. (See also W87-09568) (Author's abstract)
W87-09598

FORECASTING THE RATES OF WATER INFLOWING INTO MINES,
Mining Research Inst., Budapest (Hungary).
For primary bibliographic entry see Field 2F.
W87-09599

WATER CONTROL STRATEGY OF MINES UNDER STRONG KARSTIC WATER HAZARD,
Mining Research Inst., Budapest (Hungary).
A. Schmieder.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 535-551, 4 fig, 2 tab, 12 ref.

Descriptors: *Drainage engineering, *Mine drainage, *Groundwater movement, *Groundwater management, *Karst hydrology, *Flooding, *Mining engineering, Karst, Flood control Geohydrology, Coal mines, Case studies, Coal mining, Soil sealants.

Mine water control methods, alternatives and general strategy are discussed for mines under severe karstic water hazard. As examples, related experiences going back to more than 100 yr are shown from the Dorog and Tatabanya coalfields near Budapest, where more than 50 partial or total floodings have occurred. At present, two main groups of water control are being used in these areas: dewatering by water level lowering, and passive, preventive control. Extensive water level lowering has led to an increased karstic water withdrawal resulting in the drying out of springs and a decrease in surface water resources. Preventive control aims at the elimination, prevention and temporal delay of inrushes by using protective layer effects and preventive sealing. This type of control was developed and used extensively in the Dorog coal field. (See W87-09568) (Geiger-PTT)
W87-09600

4C. Effects On Water Of Man's Non-Water Activities

QUANTITIES OF CADMIUM, LEAD, MERCURY AND ARSENIC ENTERING THE U.K. ENVIRONMENT FROM HUMAN ACTIVITIES,
King's College, London (England). Monitoring and Assessment Research Centre.
For primary bibliographic entry see Field 5B.
W87-08728

PROPOSALS FOR AGRICULTURAL DEVELOPMENT OF WADI DHULEIL CATCHMENT, JORDAN,
Agrar-und Hydrotechnik, Essen (Germany, F.R.).
For primary bibliographic entry see Field 3F.
W87-08739

DOWNWARD MOVEMENT OF PARTLY DEGRADED MATERIALS IN DYKED MARSH SOILS,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Centre.
For primary bibliographic entry see Field 2H.
W87-08998

HABITAT MODIFICATION AND FRESHWATER FISHERIES.
Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. 278 p. Edited by John S. Alabaster.

Descriptors: *Aquatic habitats, *Fisheries, *Symposium, Canals, Rivers, Drainage, Water level, Lakes, Fish, Dams.

Changes in the environment of inland water courses, whether for industrial, agricultural, recreational or other purposes, cause changes in the habitat of the associated freshwater fisheries. This volume, the proceedings of a symposium held under the auspices of the European Inland Fisheries Advisory Commission, an organization whose objective is to promote the improvement of fisheries, reviews the effects of a range of habitat modifications and the ways in which environmental degradation may be ameliorated. Major topics discussed from both theoretical and practical viewpoints include the damming and canalization of rivers, the effects of land drainage, gravel extraction and dredging, the regulation of lake water level, water flow requirements of fish, recreational use of water and afforestation. (See also W87-09037 thru W87-09062) (Lantz-PTT)
W87-09036

DREDGING OF RAPIDS FOR TIMBER-FLOATING IN FINLAND AND ITS EFFECTS ON RIVER-SPAWNING FISH STOCKS,
Finnish Game and Fisheries Research Inst., Helsinki (Finland).
For primary bibliographic entry see Field 6G.
W87-09045

RESTORATION OF THE RIVER VAIKKOJOKI, FINLAND,
Kuopio Univ. (Finland). Dept. of Applied Zoology.
For primary bibliographic entry see Field 2H.
W87-09046

AMELIORATIVE METHODS TO REINSTATE FISHERIES FOLLOWING LAND DRAINAGE OPERATIONS,
Thames Water Authority, Nugent House, Vastern Road, Reading, Berkshire RG18DB, UK.
For primary bibliographic entry see Field 6G.
W87-09048

PHYSICAL AND BIOLOGICAL EFFECTS OF GRAVEL EXTRACTION IN RIVER BEDS,
CEMAGREF - Groupement d'Aix-en-Provence, Section Qualite des Eaux, BP99-13603, Aix-en-Provence, France.
B. Rivier, and J. Seguier.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 131-146, 5 fig, 1 tab, 61 ref.

Descriptors: *Environmental effects, *Gravel, *River beds, *Dredging, *Fish populations, Ecosystems, Ecological effects, Silting, Aquatic environment.

The extraction of alluvial material from a river bed brings about far-reaching changes in the morphodynamic conditions, not only at the extraction site itself, but also on both sides of it; suppression or destabilization of the substratum, emission into the water of fine particles that increase its turbidity and silt up the channel bottom, and modification of the flow with the appearance of supplementary erosion. These alterations in the environment upset the composition and balance of the aquatic populations and hence compromise the productive and transforming functions of the ecosystem. The extraction of material may therefore be a factor in water pollution in the same way as various kinds of effluents. The purpose of this chapter is to illustrate the main physical and biological effects of this type of activity and to suggest ways of reducing its negative effects, through discussion: (1) effects on benthic macroinvertebrates, (2) effects on aquatic flora, and (3) effects on fish populations. (See also W87-09036) (Lantz-PTT)
W87-09049

AFFORESTATION AND FISHERIES,
Freshwater Fisheries Lab., Fascally, Pitlochry, Perthshire, UK. Dept. of Agriculture and Fisheries.
H. J. Egglishaw.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 236-244, 1 tab, 55 ref.

Descriptors: *Reforestation, *Fisheries, *Lake morphology, *Ecological effects, Streams, Fish populations, Water pollution effects, Fertilizers, Forestry, Water temperature.

Covering large tracts of land with forest can produce important physical and chemical changes in lakes and streams. The literature on how these changes affect the ecology of fish (usually species of Salmonidae) and invertebrate food resources is reviewed. The most harmful effects are caused by deposition on stream beds of mineral matter eroded during the preparation of land (draining, ploughing, road construction) for tree planting. Chemicals, both biocides and fertilizers, used in forest husbandry, have affected the biota of fresh waters on many occasions. Coniferous forests are collectors of atmospheric pollutants, particularly those responsible for acid rain, and when sited in sensitive regions may cause streams and lakes to become more acid than those in neighboring unforested catchments; this increased acidity may influence egg and fry survival. Afforestation may benefit streams by increasing inputs of dead plant matter which forms the base of food chains. The cooler temperatures and decreased flows of forest streams in summer may be harmful or beneficial, depending on earlier normal values. Ways to protect surface waters from some harmful effects are given. (See also W87-09036) (Author's abstract)
W87-09061

EFFECTS OF HABITAT MODIFICATION ON FRESHWATER CRAYFISH,
Finnish Game and Fisheries Research Inst., Helsinki (Finland).
K. Westman.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 245-255, 53 ref.

Descriptors: *Crayfish, *Habitat modification, Fisheries, Construction, Turbidity, Dissolved oxygen, Acidification, Environmental effects, Fish stocking, Fish management.

Technological and economic development has caused serious damage to freshwater crayfish stocks and fisheries in Europe. The crayfish is particularly sensitive to habitat modification, because it is a slow-moving bottom-dweller confined to a relatively narrow littoral zone. Construction work frequently causes long-term turbidity in the water, increased content of suspended solids and iron, acidification, and decreased dissolved oxygen content. The crayfish is as demanding as salmonid fish in regard to the oxygen content of the water and is also very sensitive to acidification, especially under hypoxic conditions. The combined effect of simultaneous acidification and an increase in iron content often seems to be lethal. Permanent or long-term alterations of crayfish habitat are often more detrimental than the temporary changes occurring during construction work. Several environmental factors are usually responsible for the adverse effects, making it very difficult to determine the precise reasons for the damage. This also impedes the planning of restoration and management measures. Adverse effects may often be considerably reduced through the use of properly timed and appropriate construction methods. The restoration and management of crayfish stocks in permanently and profoundly modified habitats is very difficult. Management measures should be based on detailed studies made both prior to and on completion of, construction. It is usually necessary to improve or restore habitats before stocking with crayfish. (See also W87-09036) (Author's abstract)
W87-09062

URBAN STORMWATER HYDROLOGY.
American Geophysical Union, Washington, DC.
American Geophysical Union, Washington, D.C. Water Resources Monograph 7, 1982. 271 p. Edited by David F. Kibler.

Descriptors: *Urban runoff, *Urban hydrology, *Hydrologic data collections, *Rainfall-runoff relationships, *Runoff forecasting, Storm runoff, Rainfall distribution, Infiltration, Hydrologic models, Water pollution sources, Streamflow, Land use, Urban drainage, Water quality, Storm drains.

This monograph attempts to convey state-of-the-art practices in the expanding field of urban hydrology and stormwater management to engineers and urban planners as well as to graduate students in environmental or engineering disciplines. It lists practical methods and models currently in use to analyze different types of stormwater management problems and provides examples which illustrate the steps in a particular procedure or analysis. Topics covered include: urban hydrology and stormwater management, rainfall for urban stormwater design, rainfall abstractions, desk-top methods for urban stormwater calculation, urban runoff processes, quality of urban runoff, data collection and instrumentation, overview of urban stormwater models, and example model applications. (See also W87-09097 thru W87-09105) (Geiger-PTT)
W87-09096

INTRODUCTION TO URBAN HYDROLOGY AND STORMWATER MANAGMENT,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
J. W. Delleur.
IN: Urban Stormwater Hydrology, American Geophysical Union, Washington, DC. Water Resources Monograph 7, 1982. p 1-34, 6 fig, 7 tab, 85 ref.

Descriptors: *Urban hydrology, *Urban runoff, *Storm runoff, *Urban drainage, *Hydrologic models, Land use, Rainfall-runoff relationships, Overland flow, Storm drains, Infiltration, Urban planning, Urban watersheds, Water quality, Storm sewers, Groundwater recharge.

The effects of urbanization on the quantity and quality of storm runoff and the associated problems are presented in general terms. From the point of view of surface hydrology, the major changes in the runoff process in urbaninzing areas are due to two principal factors: reduced infiltration capacity, and increased hydraulic conveyance of the flow channels. A brief history of urban hydrology highlights the progress made during the last decade. The interaction of land use and urban runoff is presented in quantitative terms followed by a brief discussion of urban air quality since it affects stormwater quality. Precipitation and runoff quality are measured simultaneously by the USGS at several locations as part of the EPA/USGS Nationwide Urban Runoff Program. A section on stormwater planning in the urban metroplex is presented along with a brief discussion on urban water balance, and an introduction to stormwater and land use models and their use as elements of urban planning. Land use models are needed for projecting future drainage systems and sewer services. Computer-oriented models are required for more detailed description of land use and population distribution. Improved real-time forecasting of rainfall temporal and spatial distributions will provide substantial improvement of storm sewer system operation in urban areas. (See also W87-09096) (Geiger-PTT)
W87-09097

RAINFALL FOR URBAN STORMWATER DESIGN,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W87-09098

RAINFALL ABSTRACTIONS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W87-09099

DESK-TOP METHODS FOR URBAN STORMWATER CALCULATION,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W87-09100

URBAN RUNOFF PROCESSES,
Camp, Dresser and McKee, Inc., Annandale, VA.
For primary bibliographic entry see Field 2A.
W87-09101

QUALITY OF URBAN RUNOFF,
Camp, Dresser and McKee, Inc., Annandale, VA.
For primary bibliographic entry see Field 5B.
W87-09102

OVERVIEW OF URBAN STORMWATER MODELS,
Camp, Dresser and McKee, Inc., Annandale, VA.
S. A. Dendrou.
IN: Urban Stormwater Hydrology, American Geophysical Union, Washington, DC. Water Resources Monograph 7, 1982. p 219-247, 8 fig, 45 ref.

Descriptors: *Model studies, *Hydrologic models, *Urban runoff, *Storm runoff, *Urban hydrology, Mathematical models, Urban drainage, Project planning, Design criteria, Rainfall, Rainfall-runoff relationships, Comparison studies, Infiltration, Computer models, Water quality, Combined sewers, Storm drains.

It is useful to classify storm drainage problems and models into three levels of analysis; namely, the planning level, the analysis/design level, and the operations/control level. Prominent among the planning models is the STORM model developed for the U. S. Army, Corps of Engineers. It is intended to aid in the selection of storage and treatment facilities to control the quantity of stormwater runoff and land surface erosion. The new version of STORM called SEMSTORM which can be used for separate storm drain areas, combined sewer areas, and nonurban or unsewered areas is described. The Illinois Urban Drainage Area Simulator (ILLUDAS) is a design and analysis model capable of routing runoff flows through a sewer network. The EPA storm water management model (SWWM) is capable of simulating the effect of internal and external storage and treatment devices and the quality of the receiving waters. As a design and analysis model, SWMM can simulate diffusion, dispersion, and decay of various pollutant constituents in the network of collectors. Other design and analysis models are RUNQUAL, MITCAT and the USGS computer models for urban flood routing. The Urban Wastewater Management Model developed by Battelle Memorial Institute is discussed as an example of an operation and control model. Other models are available form the U. S. Army, Corps of Engineers and the Soil Conservation Service. The Hydrological Simulation Program (HSPF) is a complete water balance model that performs deterministic simulations of a variety of aquatic processes which occur on or under land surfaces, channels, and reservoirs. Hydraulically based models such as the CAREDAS and the HVM-QQS models developed by DORSCH CONSULT are discussed. Input data for large-scale hydrologic simulation models can be grouped into the following categories: physiographic characteristics, and specifications of the man-made drainage system itself. Model calibration, validation, and verification methods are discussed. (See also W87-09096) (Geiger-PTT)
W87-09104

EXAMPLE MODEL APPLICATIONS,
Environmental Protection Agency, Washington, DC.
H. C. Torno.
IN: Urban Stormwater Hydrology, American Geophysical Union, Washington, DC. Water Resources Monograph 7, 1982. p 249-271, 9 fig, 3 tab, 23 ref.

Descriptors: *Model studies, *Urban hydrology, *Hydrologic models, *Computer models, *Project planning, *Urban runoff, Mathematical models, Urban drainage, Urban watersheds, Flood-control storage, Flood protection, Models, Simulation analysis, Flood forecasting, Flood peak, Design criteria.

Urban runoff models may be divided into three categories according to model application: models

BRITISH EXAMPLES OF A HYDROGEOLOGICAL APPROACH TO THE EVALUATION OF DRAINAGE PROBLEMS IN SUBSURFACE ENGINEERING,
Institute of Geological Sciences, London (England).
For primary bibliographic entry see Field 2F.
W87-09593

PROBLEMS OF WATER INRUSH INTO GREEK UNDERGROUND MINES WITH SPECIAL EMPHASIS TO SEA WATER INRUSH THROUGH KARSTIC LIMESTONES OR IMPERMEABLE FORMATIONS,
Athens Univ. (Greece).
For primary bibliographic entry see Field 2F.
W87-09596

SOME HYDROGEOLOGICAL SOLUTIONS TO THE EXPLOITATION OF UNDERGROUND LIGNITE MINES (QUELQUES SOLUTIONS HYDROGEOLOGIQUES DANS LA CONSTRUCTION DES MINES DE LIGNITE SOUTERRAINES),
M. Matura, J. Mosna, and J. Koza.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 477-499, 11 fig, 1 tab, 6 ref.

Descriptors: *Drainage engineering, *Subsurface drainage, *Groundwater management, *Mine drainage, *Mining engineering, *Drainage engineering, Boreholes, Drainage systems, Drainage practices, Geohydrology, Lignite.

Lignite mining from deposits in South Moravia is conditioned by an efficient preliminary drainage system which can be achieved by several methods. Drainage by means of boreholes dirlled from the surface and in the proximity of the development workings has proven competent; after the development of the working field, the combination by means of boreholes drilled from the underground workings is continued. A method making use of four multidemsional spaces for vectorial representation of the hydrogeological quantities is described. Determination of the center of gravity of the saturated portions of the mining field is less common, but still provides a simple method of successive determination of centers of gravity in the drainage of the mining openings. (See also W87-09568) (Author's abstract)
W87-09597

SPECIAL TECHNIQUES OF GROUND TREATMENT IN MINING WORKS (LAS TECNICAS ESPECIALES DE TRATAMIENTO DEL TERRENO EN LOS TRABAJOS DE MINERIA),
Cimentaciones Especiales, S.A. Procedimientos RODIO-Madrid-Espana.
F. Muzas, and J. L. Velilla.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 501-510, 4 fig.

Descriptors: *Cements, *Soil sealants, *Mining engineering, *Mine drainage, *Mine wastes, Fate of pollutants, Membranes, Groundwater management, Soil treatment, Case studies, Soil stability, Permeability, Groundwater pollution.

The presence of water causes various problems in mining and other underground works and a range of solutions is available applying different specialized soil treatment techniques. The different problems that can occur in access work during operation and in the dumping of deads and wastes are described and classified into problems of stability, impermeability, and environmental contamination. The various specialized soil treatments applicable are reviewed and illustrated with actual examples from mining jobs and other types of underground work. (See also W87-09568) (Author's abstract)
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W87-09599

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Descriptors: *Drainage engineering, *Mine drainage, *Groundwater movement, *Groundwater management, *Karst hydrology, *Flooding, *Mining engineering, Karst, Flood control Geohydrology, Coal mines, Case studies, Coal mining, Soil sealants.

Mine water control methods, alternatives and general strategy are discussed for mines under severe karstic water hazard. As examples, related experiences going back to more than 100 yr are shown from the Dorog and Tatabanya coalfields near Budapest, where more than 50 partial or total floodings have occurred. At present, two main groups of water control are being used in these areas: dewatering by water level lowering, and passive, preventive control. Extensive water level lowering has led to an increased karstic water withdrawal resulting in the drying out of springs and a decrease in surface water resources. Preventive control aims at the elimination, prevention and temporal delay of inrushes by using protective layer effects and preventive sealing. This type of control was developed and used extensively in the Dorog coal field. (See W87-09568) (Geiger-PTT)
W87-09600

4C. Effects On Water Of Man's Non-Water Activities

QUANTITIES OF CADMIUM, LEAD, MERCURY AND ARSENIC ENTERING THE U.K. ENVIRONMENT FROM HUMAN ACTIVITIES,
King's College, London (England). Monitoring and Assessment Research Centre.
For primary bibliographic entry see Field 5B.
W87-08728

PROPOSALS FOR AGRICULTURAL DEVELOPMENT OF WADI DHULEIL CATCHMENT, JORDAN,
Agrar-und Hydrotechnik, Essen (Germany, F.R.).
For primary bibliographic entry see Field 3F.
W87-08739

DOWNWARD MOVEMENT OF PARTLY DEGRADED MATERIALS IN DYKED MARSH SOILS,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Centre.
For primary bibliographic entry see Field 2H.
W87-08998

HABITAT MODIFICATION AND FRESHWATER FISHERIES.
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Descriptors: *Aquatic habitats, *Fisheries, *Symposium, Canals, Rivers, Drainage, Water level, Lakes, Fish, Dams.

Changes in the environment of inland water courses, whether for industrial, agricultural, recreational or other purposes, cause changes in the habitat of the associated freshwater fisheries. This volume, the proceedings of a symposium held under the auspices of the European Inland Fisheries Advisory Commission, an organization whose objective is to promote the improvement of fisheries, reviews the effects of a range of habitat modifications and the ways in which environmental degradation may be ameliorated. Major topics discussed from both theoretical and practical viewpoints include the damming and canalization of rivers, the effects of land drainage, gravel extraction and dredging, the regulation of lake water level, water flow requirements of fish, recreational use of water and afforestation. (See also W87-09037 thru W87-09062) (Lantz-PTT)
W87-09036

DREDGING OF RAPIDS FOR TIMBER-FLOATING IN FINLAND AND ITS EFFECTS ON RIVER-SPAWNING FISH STOCKS,
Finnish Game and Fisheries Research Inst., Helsinki (Finland).
For primary bibliographic entry see Field 6G.
W87-09045

RESTORATION OF THE RIVER VAIKKOJOKI, FINLAND,
Kuopio Univ. (Finland). Dept. of Applied Zoology.
For primary bibliographic entry see Field 2H.
W87-09046

AMELIORATIVE METHODS TO REINSTATE FISHERIES FOLLOWING LAND DRAINAGE OPERATIONS,
Thames Water Authority, Nugent House, Vastern Road, Reading, Berkshire RG18DB, UK.
For primary bibliographic entry see Field 6G.
W87-09048

PHYSICAL AND BIOLOGICAL EFFECTS OF GRAVEL EXTRACTION IN RIVER BEDS,
CEMAGREF - Groupement d'Aix-en-Provence, Section Qualite des Eaux, BP99-13603, Aix-en-Provence, France.
B. Rivier, and J. Seguier.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 131-146, 5 fig, 1 tab, 61 ref.

Descriptors: *Environmental effects, *Gravel, *River beds, *Dredging, *Fish populations, Ecosystems, Ecological effects, Silting, Aquatic environment.

The extraction of alluvial material from a river bed brings about far-reaching changes in the morphodynamic conditions, not only at the extraction site itself, but also on both sides of it; suppression or destabilization of the substratum, emission into the water of fine particles that increase its turbidity and silt up the channel bottom, and modification of the flow with the appearance of supplementary erosion. These alterations in the environment upset the composition and balance of the aquatic populations and hence compromise the productive and transforming functions of the ecosystem. The extraction of material may therefore be a factor in water pollution in the same way as various kinds of effluents. The purpose of this chapter is to illustrate the main physical and biological effects of this type of activity and to suggest ways of reducing its negative effects, through discussion: (1) effects on benthic macroinvertebrates, (2) effects on aquatic flora, and (3) effects on fish populations. (See also W87-09036) (Lantz-PTT)
W87-09049

AFFORESTATION AND FISHERIES,
Freshwater Fisheries Lab., Fascally, Pitlochry, Perthshire, UK. Dept. of Agriculture and Fisheries.
H. J. Egglishaw.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 236-244, 1 tab, 55 ref.

Descriptors: *Reforestation, *Fisheries, *Lake morphology, *Ecological effects, Streams, Fish populations, Water pollution effects, Fertilizers, Forestry, Water temperature.

Covering large tracts of land with forest can produce important physical and chemical changes in lakes and streams. The literature on how these changes affect the ecology of fish (usually species of Salmonidae) and invertebrate food resources is reviewed. The most harmful effects are caused by deposition on stream beds of mineral matter eroded during the preparation of land (draining, ploughing, road construction) for tree planting. Chemicals, both biocides and fertilizers, used in forest husbandry, have affected the biota of fresh waters on many occasions. Coniferous forests are collectors of atmospheric pollutants, particularly those responsible for acid rain, and when sited in sensitive regions may cause streams and lakes to become more acid than those in neighboring unforested catchments; this increased acidity may influence egg and fry survival. Afforestation may benefit streams by increasing inputs of dead plant matter which forms the base of food chains. The cooler temperatures and decreased flows of forest streams in summer may be harmful or beneficial, depending on earlier normal values. Ways to protect surface waters from some harmful effects are given. (See also W87-09036) (Author's abstract)
W87-09061

EFFECTS OF HABITAT MODIFICATION ON FRESHWATER CRAYFISH,
Finnish Game and Fisheries Research Inst., Helsinki (Finland).
K. Westman.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 245-255, 53 ref.

Descriptors: *Crayfish, *Habitat modification, Fisheries, Construction, Turbidity, Dissolved oxygen, Acidification, Environmental effects, Fish stocking, Fish management.

Technological and economic development has caused serious damage to freshwater crayfish stocks and fisheries in Europe. The crayfish is particularly sensitive to habitat modification, because it is a slow-moving bottom-dweller confined to a relatively narrow littoral zone. Construction work frequently causes long-term turbidity in the water, increased content of suspended solids and iron, acidification, and decreased dissolved oxygen content. The crayfish is as demanding as salmonid fish in regard to the oxygen content of the water and is also very sensitive to acidification, especially under hypoxic conditions. The combined effect of simultaneous acidification and an increase in iron content often seems to be lethal. Permanent or long-term alterations of crayfish habitat are often more detrimental than the temporary changes occurring during construction work. Several environmental factors are usually responsible for the adverse effects, making it very difficult to determine the precise reasons for the damage. This also impedes the planning of restoration and management measures. Adverse effects may often be considerably reduced through the use of properly timed and appropriate construction methods. The restoration and management of crayfish stocks in permanently and profoundly modified habitats is very difficult. Management measures should be based on detailed studies made both prior to and on completion of, construction. It is usually necessary to improve or restore habitats before stocking with crayfish. (See also W87-09036) (Author's abstract)
W87-09062

URBAN STORMWATER HYDROLOGY.
American Geophysical Union, Washington, DC. American Geophysical Union, Washington, D.C. Water Resources Monograph 7, 1982. 271 p. Edited by David F. Kibler.

Descriptors: *Urban runoff, *Urban hydrology, *Hydrologic data collections, *Rainfall-runoff relationships, *Runoff forecasting, Storm runoff, Rainfall distribution, Infiltration, Hydrologic models, Water pollution sources, Streamflow, Land use, Urban drainage, Water quality, Storm drains.

This monograph attempts to convey state-of-the-art practices in the expanding field of urban hydrology and stormwater management to engineers and urban planners as well as to graduate students in environmental or engineering disciplines. It lists practical methods and models currently in use to analyze different types of stormwater management problems and provides examples which illustrate the steps in a particular procedure or analysis. Topics covered include: urban hydrology and stormwater management, rainfall for urban stormwater design, rainfall abstractions, desk-top methods for urban stormwater calculation, urban runoff processes, quality of urban runoff, data collection and instrumentation, overview of urban stormwater models, and example model applications. (See also W87-09097 thru W87-09105) (Geiger-PTT)
W87-09096

INTRODUCTION TO URBAN HYDROLOGY AND STORMWATER MANAGMENT,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
J. W. Delleur.
IN: Urban Stormwater Hydrology, American Geophysical Union, Washington, DC. Water Resources Monograph 7, 1982. p 1-34, 6 fig, 7 tab, 85 ref.

Descriptors: *Urban hydrology, *Urban runoff, *Storm runoff, *Urban drainage, *Hydrologic models, Land use, Rainfall-runoff relationships, Overland flow, Storm drains, Infiltration, Urban planning, Urban watersheds, Water quality, Storm sewers, Groundwater recharge.

The effects of urbanization on the quantity and quality of storm runoff and the associated problems are presented in general terms. From the point of view of surface hydrology, the major changes in the runoff process in urbaninzing areas are due to two principal factors: reduced infiltration capacity, and increased hydraulic conveyance of the flow channels. A brief history of urban hydrology highlights the progress made during the last de . The interaction of land use and urban run is presented in quantitative terms followed by a brief discussion of urban air quality since it affects stormwater quality. Precipitation and runoff quality are measured simultaneously by the USGS at several locations as part of the EPA/USGS Nationwide Urban Runoff Program. A section on stormwater planning in the urban metroplex is presented along with a brief discussion on urban water balance, and an introduction to stormwater and land use models and their use as elements of urban planning. Land use models are needed for projecting future drainage systems and sewer services. Computer-oriented models are required for more detailed description of land use and population distribution. Improved real-time forecasting of rainfall temporal and spatial distributions will provide substantial improvement of storm sewer system operation in urban areas. (See also W87-09096) (Geiger-PTT)
W87-09097

RAINFALL FOR URBAN STORMWATER DESIGN,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W87-09098

RAINFALL ABSTRACTIONS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W87-09099

DESK-TOP METHODS FOR URBAN STORMWATER CALCULATION,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W87-09100

URBAN RUNOFF PROCESSES,
Camp, Dresser and McKee, Inc., Annandale, VA.
For primary bibliographic entry see Field 2A.
W87-09101

QUALITY OF URBAN RUNOFF,
Camp, Dresser and McKee, Inc., Annandale, VA.
For primary bibliographic entry see Field 5B.
W87-09102

OVERVIEW OF URBAN STORMWATER MODELS,
Camp, Dresser and McKee, Inc., Annandale, VA.
S. A. Dendrou.
IN: Urban Stormwater Hydrology, American Geophysical Union, Washington, DC. Water Resources Monograph 7, 1982. p 219-247, 8 fig, 45 ref.

Descriptors: *Model studies, *Hydrologic models, *Urban runoff, *Storm runoff, *Urban hydrology, Mathematical models, Urban drainage, Project planning, Design criteria, Rainfall, Rainfall-runoff relationships, Comparison studies, Infiltration, Computer models, Water quality, Combined sewers, Storm drains.

It is useful to classify storm drainage problems and models into three levels of analysis; namely, the planning level, the analysis/design level, and the operations/control level. Prominent among the planning models is the STORM model developed for the U. S. Army, Corps of Engineers. It is intended to aid in the selection of storage and treatment facilities to control the quantity of stormwater runoff and land surface erosion. The new version of STORM called SEMSTORM which can be used for separate storm drain areas, combined sewer areas, and nonurban or unsewered areas is described. The Illinois Urban Drainage Area Simulator (ILLUDAS) is a design and analysis model capable of routing runoff flows through a sewer network. The EPA storm water management model (SWWM) is capable of simulating the effect of internal and external storage and treatment devices and the quality of the receiving waters. As a design and analysis model, SWMM can simulate diffusion, dispersion, and decay of various pollutant constituents in the network of collectors. Other design and analysis models are RUNQUAL, MITCAT and the USGS computer models for urban flood routing. The Urban Wastewater Management Model developed by Battelle Memorial Institute is discussed as an example of an operation and control model. Other models are available form the U. S. Army, Corps of Engineers and the Soil Conservation Service. The Hydrological Simulation Program (HSPF) is a complete water balance model that performs deterministic simulations of a variety of aquatic processes which occur on or under land surfaces, channels, and reservoirs. Hydraulically based models such as the CAREDAS and the HVM-QQS models developed by DORSCH CONSULT are discussed. Input data for large-scale hydrologic simulation models can be grouped into the following categories: physiographic characteristics, and specifications of the man-made drainage system itself. Model calibration, validation, and verification methods are discussed. (See also W87-09096) (Geiger-PTT)
W87-09104

EXAMPLE MODEL APPLICATIONS,
Environmental Protection Agency, Washington, DC.
H. C. Torno.
IN: Urban Stormwater Hydrology, American Geophysical Union, Washington, DC. Water Resources Monograph 7, 1982. p 249-271, 9 fig, 3 tab, 23 ref.

Descriptors: *Model studies, *Urban hydrology, *Hydrologic models, *Computer models, *Project planning, *Urban runoff, Mathematical models, Urban drainage, Urban watersheds, Flood-control storage, Flood protection, Models, Simulation analysis, Flood forecasting, Flood peak, Design criteria.

Urban runoff models may be divided into three categories according to model application: models

for planning future alternatives, models for analyzing existing systems or alternatives, and models for designing a system for which planning or analysis is complete. No single model is uniquely suited for a specific problem and some problems require more than one model for their solution. Several planning and analysis models were applied to the flooding problem caused by poor urban drainage in the Four Mile Run watershed. The STORM model was used to develop flood frequency curves, while the WATERSHED model was used to simulate surface flow from individual subcatchments, pipes, and open channels. These simulations helped to ensure that future modifications in the watershed will not lead to future flooding problems. Planning and analysis models were used to reduce pollution load to the Sandusky River from combined sewer overflows in Bucyrus, Ohio (the Stormwater Management Model or SWMM) and to design and analyze urban drainage systems in Edmonton , Alberta (the HYMO model, STORM, and SWMM). The use of a planning and analysis model to extend a limited data set in a study done by the Illinois State Water Survey in Bloomington-Normal, Illinois is described. Here the QUALILLUDAS model was used to assess the effects of storm runoff, point sources, and combined sewer overflows to establish the variability of constituent levels over time to aid in the planning of urban stormwater facilities. The EXTRAN (Extended Transport) block of the SWMM program was used to optimize the construction of relief sewers in the Borough of East York, Toronto. Three planning and analysis models, SEMSTORM, RUNOFF, and TRANSPORT, were used to assess the non-point source contribution to the pollution of Dorchester Bay from combined sewer overflows in Boston, Massachusetts. Other model applications open to the creative planner are considered. (See also W87-09096) (Geiger-PTT)
W87-09105

IMPACT OF AGRICULTURE ON SURFACE WATER IN IRELAND: PART I. GENERAL,
Foras Forbartha, Teoranta, Dublin (Ireland). Water Resources Div.
For primary bibliographic entry see Field 5B.
W87-09199

IMPACT OF AGRICULTURE ON SURFACE WATER IN IRELAND: PART II. PROSPECTS FOR THE FUTURE,
Foras Taluntais, Ballinrobe (Ireland). Johnstown Castle Research Centre.
M. Sherwood.
Environmental Geology and Water Sciences EGWSEI, Vol. 9, No. 1, p 11-14, 1986. 1 fig, 6 tab, 5 ref.

Descriptors: *Farm wastes, *Water pollution sources, *Ireland, *Surface water, *Agricultural runoff, *Eutrophication, Runoff, Agriculture, Cattle, Manure, Fertilizers, Land disposal, Agricultural chemicals, Silage, Feeds, Hogs, Phosphates, Trophic level.

The causes and sources of pollution from agricultural wastes in Ireland and the likely direction of future trends are reviewed. Farmyard manure poses little threat to the environment, although dungsteads are a definite pollution hazard. Silage effluent is responsible for more fish kills than any other single factor; silage production has increased dramatically over the past 20 years, and the effluent has a very high BOD value (65,000 mg/l) and is produced when the volume of river flow is low and oxygen content of the water is reduced. The concentrations of nutrients in runoff water at different time intervals following spreading of pig slurry in field experiments is discussed. While BOD concentration fell rapidly, the P concentration was still 7 mg/l after three weeks, a level which would contribute to lake eutrophication. With respect to fertilizers, the concentration in runoff water falls more rapidly with fertilizer P than with slurry P. It is concluded that the use of fertilizer N will continue, leading to higher nitrates in rivers and groundwater, although nitrate-N concentrations are not likely to exceed the WHO-recommended upper limit of 11.3 mg/l in the near future. (See also W87-09199) (Doria-PTT)
W87-09200

GEOCHEMICAL STUDIES IN THE DRAINAGE BASIN OF THE RIO VOUGA, PORTUGAL. IV. IMPACT OF LAND USE ON THE HYDROGEOCHEMISTRY OF NATURAL WATERS IN THE VOUZELA REGION,
Utrecht Univ. (Netherlands). Dept. of Geochemistry.
R. N. J. Comans, C. H. van der Weijden, and S. P. Vriend.
Environmental Geology and Water Sciences EGWSEI, Vol. 9, No. 2, p 119-128, 1987. 7 fig, 3 tab, 17 ref, 1 append.

Descriptors: *Geochemistry, *Catchment areas, *Portugal, *Land use, *Chemical composition, *Statistical analysis, Drainage, Analysis of variance, Nutrients, Sodium, Potassium, Calcium, Magnesium, Strontium, Chlorides, Sulfates, Nitrates, Sampling, Springs, Streams, Trace elements, Fertilizers, Evaporation, Irrigation, Evapotranspiration, Chemistry, Chemical properties.

A hydrogeochemical study of the impact of land use on the composition of natural waters in the Vouzela region in northern Portugal was carried out during the summer of 1983. Water samples were collected from springs and major streams in the area. Analysis of variance and subsequent pairwise contrast tests demonstrated that waters from agricultural areas are significantly enriched in Na, K, Ca, Mg, Sr, Cl, SO4, and NO3. High concentrations of these ions in agricultural areas result from both the application of fertilizers and enhanced evaporation by the intensive irrigation of agricultural lands. Constituents such as H4SiO4, HCO3, F, and probably Li, which are typically related to mineral weathering, were not affected by land use. In waters from forested areas, the concentration of most constituents was about 20% higher than in waters from uncultivated areas with mainly a grass cover. This reflects the difference in the evapotranspiration of these two vegetation types. The chemistry of the Rio Zela clearly reflects differences in land use in the Rio Zela valley. (Author's abstract)
W87-09207

WETLANDS POLICY CRISIS: UNITED STATES AND UNITED KINGDOM,
Battelle Memorial Inst., Denver, CO. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 6E.
W87-09215

STATE OF THE ENVIRONMENT, 1985.
Organization for Economic Co-Operation and Development, Paris (France).
For primary bibliographic entry see Field 6G.
W87-09336

PLANTS AND PEAT CUTTINGS: HISTORICAL ECOLOGY OF A MUCH EXPLOITED PEAT LAND-THORNE WASTE. YORKSHIRE, UK,
The University, Sheffield (England). Dept. of Botany.
P. J. Smart, B. D. Wheeler, and A. J. Willis.
New Phytologist NEWHAV, Vol. 104. No. 4, p 731-748 December 1986. 6 fig, 2 tab, 44 ref.

Descriptors: *Ecology, *Thorne Waste, *Raised bogs, *Peatland reclamation, *Peat cuttings, *Wetland conservation, Plants, Species composition.

Although many lowland bogs have been much modified or completely destroyed by agricultural reclamation, peat cutting, unaccompanied by reclamation, is not necessarily so destructive and abandoned workings may provide a range of habitats that can support the original wet land plant species. Thorne Waste, a much exploited raised bog in eastern England, has a varied and well documented management history and comparatively good botanical records. It thus provides an exemplary site to assess the effect of peat exploitation upon its flora. The origin and development, and subsequent drainage, reclamation and peat extract history of the site are described and their impact upon the past and present flora is evaluated. Some ombrotropohic mire species have been lost from the site, but one section of peat cuttings (the Dutch canal system, abandoned about 1920) has revegetated and supports an important range of these plants. Fen species which once occupied the marginal lagg, have been almost completely eliminated from their sites (which have mostly been reclaimed) but many have become reestablished in various new habitats created within the peat cutting complex. This illustrates the potential of artificial modification of worked over peatland sites to sustain a range of wetland plants. (Author's abstract)
W87-09342

LLNL GROUNDWATER QUALITY: SAMPLING OF SEVEN SHALLOW WELLS ON THE LLNL SITE,
Lawrence Livermore National Lab., CA.
For primary bibliographic entry see Field 5B.
W87-09458

EXAMINATION OF TIDAL FLATS, VOL. 1: RESEARCH REPORT.
Virginia Inst. of Marine Science, Gloucester Point. Available from the National Technical Information Service, Springfield, VA 22161, as PB83-131789, A05 in paper copy, A01 in microfiche. Report No. FHWA/RD-80/181, June 1982. Final Report. Federal Highway Administration, Office of Research, Washington, DC. 82 p, 10 fig, 35 tab, 26 ref. Edited by R. J. Diaz. Contract No. DOT-FH-11-9360.

Descriptors: *Tidal flats, *Wetlands, *Habitats, *Evaluation, *Primary productivity, *Highway effects, *Marsh management, *Salt marshes, Mud flats, Secondary productivity, Environmental effects, Data collections, Ecological effects, Literature review.

This report is the first of three, documenting a study titled 'Evaluation of Tidal Flat Areas for Highway Planning and Design.' It summarizes the data collected on the biological processes and communities of tidal flats and can be used as an aid in determining which processes and communities would be best suited for inclusion in the evaluation methodology. Analyses of these and other data on tidal flats have shown that attempts to establish guidelines for evaluation should include the type of habitat (grass bed, sand or mud flat), season, and geographic location. The relationship between primary productivity and these parameters is not clearly understood. In view of the large number of physical and biological variables affecting tidal flats value, any plan for their evaluation should provide adequate consideration of primary and secondary (invertebrate) production, fisheries data, and spatial and temporal variation within these components. (Geiger-PTT)
W87-09492

EXAMINATION OF TIDAL FLATS, VOL. 3: EVALUATION METHODOLOGY.
Virginia Inst. of Marine Science, Gloucester Point. Available from the National Technical Information Service, Springfield, VA 22161, as PB83-131805, A04 in paper copy, A01 in microfiche. Report No. FHWA/RD-80/183, June 1982. Final Report. Federal Highway Administration, Office of Research, Washington, DC. 50 p, 4 fig, 3 tab, 4 append, 3 ref. Edited by R. J. Diaz. DOT-FH-11-9360.

Descriptors: *Wildlife habitat, *Ecological effects, *Environmental effects, *Project planning, *Tidal flats, *On-site data collections, *Highway effects, Evaluation, Data interpretation, Fisheries, Habitats, Data collections.

An approach to the evaluation of tidal flats which centers around state-of-the-art knowledge for assessing the values of tidal flats and establishing the basis for comparison of specific sites is described. Actual field data collected from various tidal flat areas around the United States and the world were used to form the quantitative base for establishing values of tidal flat environments. While all areas have not been studied, sufficient data exists to

establish a range of values for a given parameter for a given tidal flat. Two categories of parameters identified as important for determining tidal flat value are the primary producers (chlorophyll a concentration and light intensity) and support populations (annelid, mollusc, and crustacean biomass and abundance). These specific parameters reflect the ability of tidal flats to support fishery and wildlife populations. The methodology involves the assigning of scaled value indices to all parameters considered. Interpretation of results involves recourse to the basis goals of comparing habitats within a project site for baseline conditions, comparing alternate project sites, projecting habitat modifications from a project, and planning mitigation efforts. (Geiger-PTT)
W87-09493

STREAM WATER QUALITY IN THE COAL REGION OF VIRGINIA,
Northeastern Forest Experiment Station, Broomall, PA.
K. L. Dyer.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-126565, A05 in paper copy, A01 in microfiche. General Technical Report NE-78, 1982. 68 p, 20 fig, 34 tab, 8 ref.

Descriptors: *Baseline studies, *Coal mining effects, *Water quality, *Hydrologic data collections, *Coal mining, *Small watersheds, Streams, On-site data collections, Alkalinity, Hydrogen ion concentration, Acidity, Turbidity, Trace elements, Water temperature, Suspended solids, Specific conductivity, Phosphorous, Nitrogen, Ions, Watersheds.

Water quality data was collected in 1977-1979 from 12 small streams draining unmined watersheds and 19 streams draining areas where coal has been surface-mined to establish a data base for small watersheds throughout Appalachia. The streams represented seven counties in western Virginia. The data should aid in identifying changes in water quality attributable to past and recent surface mining. Most of the streams were sampled at approximately monthly intervals. Thirty-one elements were analyzed by emission spectrometry. Other parameters sampled included acidity, alkalinity, pH, five N and P species, specific conductance, suspended solids, turbidity, water temperature, settleable matter, common ions, and estimated discharge. The data base provided in this report for small reference watersheds should provide a basis for future studies and be especially useful in determining the probable hydrologic consequences of future mining operations. (Geiger-PTT)
W87-09494

WATER IN MINING AND UNDERGROUND WORKS (EL AGUA EN LA MINERIA Y TRABAJOS SUBTERRANEOS), VOLUMES I AND II.
Asociacion Nacional de Ingenieros de Minas, Consejo Superior de Colegios de Ingenioeros de Minas, Granada (Spain).
For primary bibliographic entry see Field 2F.
W87-09568

INFLUENCE ON THE GROUNDWATER CONDITIONS IN A MULTILAYERED AQUIFER SYSTEM BY ALUM-SHALE MINING,
Loussavaara-Kirunavaara AB, Skovde (Sweden).
For primary bibliographic entry see Field 5C.
W87-09570

MINE DRAINAGE PROBLEMS IN INDIAN COALFIELDS, WITH SPECIAL REFERENCE TO THE PROBLEMS IN JHARIA COALFIELD,
Indian School of Mines, Bihar (India). Dept. of Mining Engineering.
S. P. Banerjee, and R. S. Shylienger.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 27-44, 4 fig, 1 tab, 3 ref.

Descriptors: *Mine drainage, *Mining engineering, *Coal mining, *Excavation, *Coal mines, Hydraulic mining, Monsoons, Groundwater movement, Statistical methods, Mathematical studies, Mine wastes, Water reuse, Groundwater pollution, Acid mine drainage.

With an annual production of approximately 100 million tons, India ranks sixth amongst the largest producers of hard coal in the world. The hydrogeological problems in the different coalfields of India are different. At Neyveli, the groundwater occurs under subartesian pressure. In some of the Central Indian Coalfields the loosely consolidated highly porous sandstones overlying the coal seams give rise to problems of high water inflow. The greatest hydrological problem is created by heavy seasonal rainfalls during the monsoons. Examples of hydrological tests carried out in Indian mines and application of statistical methods in calculating the lodgement capacity in opencast mines are given. Results of a case study of energy consumption in a group of collieries in Jharia coalfield during the monsoon and non-monsoon periods are incorporated to show the strong correlation between the rain fall and the pumping load. The method of hydrological tests for new mine sites is briefly described and examples of physical and chemical tests on underground water samples are given. The use of the mine water for industrial and domestic purposes is discussed. (See also W87-09568) (Author's abstract)
W87-09571

INFLUENCE OF STRUCTURE ON UNDERGROUND WATER PREDICTION AND OCCURRENCE AT ROKANA MINE, KITWE, ZAMBIA,
Nchanga Consolidated Copper Mines Limited, Kitwe (Zambia). Geology Dept.
For primary bibliographic entry see Field 2F.
W87-09572

HYDROGEOLOGY OF UNDERGROUND COAL MINES IN ILLINOIS,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 2F.
W87-09573

ATTEMPTS TO DETERMINE THE VIABILITY OF A DEEP EXCAVATION ON THE COAST OF THE VANDELLOS MASSIF (TARRAGONA, SPAIN) (ENSAYOS PARA DETERMINAR LA VIABILIDAD DE UNA EXCAVACION PROFUNDA EN EL LITORAL DEL MACIZO DE VANDELLOS (TARRAGONA, EXPANA)),
Curso Internacional de Hidrologia Subterranea y Comisaria de Aguas del Pirineo Oriental, Barcelona (Spain).
For primary bibliographic entry see Field 2F.
W87-09574

HYDROGEOLOGIC FACTORS THAT MAY AFFECT MINE DRAINAGE IN THE ANTHRACITE REGION OF PENNSYLVANIA, EASTERN UNITED STATES,
Geological Survey, Harrisburg, PA.
D. J. Growitz.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 153-172, 5 fig, 6 tab, 10 ref.

Descriptors: *Mine drainage, *Coal mines, *Pennsylvania, *Water quality, *Water pollution sources, Geohydrology, Groundwater movement, Pumping, Strip mine wastes, Strip mines, Retention time, Coal mining, Groundwater pollution, Streamflow.

Hydrologic and water-quality data collected during a 2-week period of average flow were used in a regional analysis of mine drainage in the anthracite coal region of Pennsylvania. Results of the study show that the flow and quality of mine drainage are influenced by the proportion of land surface in the coal fields that is disturbed by mining, the residence time of mine water, changes in the hydrologic system due to cessation of pumping and the recovery of water levels, and the method of mining used. Water quality is worse from underground operations than stripping operations. During earlier years when pumping predominated, water quality from mine drainage was worse than that being produced at present by gravity overflows. Findings in this study will be useful for understanding and helping to alleviate some of the mine-drainage problems in the anthracite region as well as having transfer value to other mining areas. (Geiger-PTT)
W87-09577

PROPOSED HYDROGEOLOGICAL MODEL FOR FUTURE LIGNITE MINING AND GROUNDWATER DRAINAGE IN THE HULA BASIN, NORTHERN ISRAEL,
Geological Survey of Israel, Jerusalem. Hydrogeological Div.
For primary bibliographic entry see Field 2F.
W87-09578

APPLICATION OF ISOTOPE TECHNIQUES AND WELL LOGGIND IN INVESTIGATING GROUND WATER INFLUENCED BY MINING,
Charles Univ., Praha (Czechoslovakia). Faculty of Science.
For primary bibliographic entry see Field 2F.
W87-09580

INFLUENCE OF UNDERGROUND ENGINEERING WORKS ON HYDROGEOLOGICAL CONDITIONS OF THE SUBURBAN AREAS,
Comenius Univ., Bratislava (Czechoslovakia). Dept. of Hydrogeology.
For primary bibliographic entry see Field 2F.
W87-09581

DEVELOPMENT OF A GROUND WATER HAZARD MAP FOR AN UNDERGROUND COAL MINE,
D'Appolonia Consulting Engineers, Inc., Englewood, CO.
For primary bibliographic entry see Field 2F.
W87-09585

HYDROGEOLOGICAL ASPECTS OF COAL MINING UNDER STORED WATERS NEAR SYDNEY, AUSTRALIA,
Water Resources Commission, Sydney (Australia).
For primary bibliographic entry see Field 2F.
W87-09587

WATER HAZARD IN DEEP GOLD MINING OF THE FAR WEST WITWATERSRAND - SOUTH AFRICA,
Gold Fields of South Africa Ltd., Carletonville (South Africa).
For primary bibliographic entry see Field 2F.
W87-09588

PLANS AND EXPERIMENTS TO DEAL WITH LARGE AMOUNTS OF SEDIMENT IN HUNGARIAN MINES UNDER KARSTIC WATER HAZARD,
Mining Research Inst., Budapest (Hungary).
I. Bagdy, L. Kocsanyi, and Z. Kesseru.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 359-371, 3 fig, 25 ref.

Descriptors: *Groundwater movement, *Sediment transport, *Mine drainage, *Project planning, *Karst, Mining engineering, Pumping, Sedimentation, Dewatering, Design criteria, Hydraulic transportation, Sumps, Subsurface drainage.

Due to environmental constraints, water control systems of mines under water hazard could yield discharges of 80-120 cu m/min and also high amounts of sediment on the order of 6 tons/min for several days. Results of investigations of several types of sediment settlers are reviewed. Settlers considered include those from mining applications and those from surface water treatment. The efficiencies of the simple sump, twin sump, South African vertical settler, two-level settler, vertical-flow settler, radial-flow settler, longitudinal-flow settler, sand trap, and hydrocyclone are compared.

Sediment treatment consists of dewatering and transport by belt-conveyor, or hydraulic transport in a slurry form. Since the belt cannot dewater particles <0.2 mm, the hydraulic transport method proved to be the only realistic alternative. A pilot station is being constructed to check different settling system elements in their original size under real sediment conditions. (See also W87-09568) (Geiger-PTT)
W87-09590

4D. Watershed Protection

DEFENDING OUR LAKESHORES,
W. S. Hamilton.
Civil Engineering CEWRA9, Vol. 57, No. 4, p 75-77, April 1987.

Descriptors: *Revetments, *Lake shores, *Lakes, *Water level, Water level fluctuations, Flood damage, Great Lakes, Lake Michigan, Lake Huron, Armor stones, Fluctuations, Seasonal variation.

The water level of Lake Michigan and Huron has been fluctuating throughout history, but the current high levels, 581.3 feet in the summer of 1986, were also recorded in 1886. Exceptional low levels of 575.4 feet were also recorded since the written records began in 1860. The still-water level, therefore, should be expected to rise and fall at least 6 feet over the years and seasonal fluctuation and wind make additional contributions to the height of the water in the lakes. Several costly methods for controlling the lake levels during periods of high water supply were presented; all decreased the input or increased the output of the system. Engineering methods of coping with the 6 foot fluctuations of the lake system attempt to alleviate damage to buildings, reduce erosion, and maintain beaches by erecting seawalls, groins and piers. In order to protect these structures from waves and erosion, placing an armor stone revetment along the seawall and extending it as an offshore breakwater was proposed. Engineers chose armor stones of 3 to 5 tons for stability in waves up to 11 feet and constructed the 700 foot long revetment for condominium owners in Wilmette which is located north of Chicago. Previous damage was repaired and the property protection increased by the addition of the revetment. (Wood-PTT)
W87-08674

EROSION AND SEDIMENT CONTROL HANDBOOK,
California Tahoe Conservancy.
S. J. Goldman, K. Jackson, and T. A. Bursztynsky.
McGraw-Hill Book Co., New York, NY. 1986. 443 p.

Descriptors: *Erosion control, *Sediment control, *Handbooks, Erosion, Economic aspects, Sedimentation, Mathematical methods, Runoff, Universal soil loss equation, Vegetation, Dikes, Silting, Drains.

This handbook on erosion and sediment control is an outgrowth of a series of professional seminars. The handbook is organized into chapters on each of the major subject areas of erosion control. Chapter 1 describes erosion problems, including both environmental impacts and economic costs. It also describes the erosion process. Chapter 2 outlines ten basic strategies for preventing erosion and trapping sediment. Chapter 3 describes how to set up and enforce an effective erosion and sediment control program in a city or county, and it outlines the key features of an effective erosion and sediment control ordinance. This chapter also includes detailed data on private sector costs for constructing control measures and public agency costs for implementing a control program. Chapter 4 shows how to use the rational formula to estimate runoff volumes for sizing temporary erosion and sediment control measures. Emphasis is on the use of short-duration rainfall intensity data. Chapter 5 describes how to use the universal soil loss equation to estimate the volume of sediment likely to be eroded from a construction site. Chapter 6 discusses how to use plants and mulches to protect graded areas from erosion. It rates the effectiveness and cost-effectiveness of seven common revegetation techniques, describes the characteristics of plants that are effective in controlling erosion, and lists sources of information on suitable plant types throughout the world. Chapter 7 provides guidelines for designing water conveyance and energy dissipation structures such as dikes, swales, sample designs, and practical tips for designers and builders. Chapter 8 shows how to design and construct sediment basins and traps, straw bale dikes, and silt fences. The first part of Chapter 9 shows how to develop an erosion and sediment control plan for a site. The step-by-step planning process is illustrated with examples from an actual project. The last part of the chapter gives a method, designed for public officials, for evaluating the adequacy of an erosion and sediment control plan, and it includes a plan review checklist. Chapter 10 covers control measure maintenance. (Lantz-PTT)
W87-08686

EFFECT OF EXCHANGEABLE SODIUM PERCENT ON SURFACE SEALING,
Central Soil Salinity Research Inst., Karnal (India).
D. K. Painuli, and I. P. Abrol.
Agricultural Water Management AWMADF, Vol. 11, No. 3/4, p 247-256, September 1986. 6 fig, 19 ref.

Descriptors: *Sodium, *Surface sealing, *Infiltration, *Evaporation, *Hydraulic conductivity, Loam, Sand, Soil water.

Laboratory studies were conducted to evaluate the effect of exchangeable sodium percent (ESP) on soil surface sealing and of surface sealing on infiltration and evaporation processes. Surface seals with hydraulic conductances .05220, .04920, .03900, .03300, and .01791/h were attained on top of a sandy loam soil with ESP of 4 by placing a 5-mm layer of the same soil with ESP's 6, 10, 20, 30, and 60 respectively. Surface sealing increased with increasing ESP and appeared complete at ESP 30. Evaporation remained unaffected by the seals. Infiltration, however, was considerably reduced. Soil water profiles, which largely depended on the amount of infiltrated water, tended to become uniform. Equal moisture contents were also observed under evaporation. (Author's abstract)
W87-08742

STREAMBANK PROTECTION BY SUBMERGED VANES,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
A. J. Odgaard, and C. E. Mosconi.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 113, No. 4, p 520-536, April 1987. 6 fig, 3 tab, 16 ref, 1 append.

Descriptors: *Stream banks, *Bank protection, *Submerged vanes, *Hydraulic structures, *Hydraulic design, Performance evaluation, Banks, Protection, Engineering, Hydraulic engineering, Flow, Flow characteristics, Scour, Channel scour.

A summary is given of the design, installation, and performance of a system of submerged vanes ('Iowa Vanes') for erosion protection in a bend of East Nishnabotna River, Iowa. The system functions by eliminating or reducing the centrifugally induced helical motion of the flow (the root cause of bank undermining). The system was installed during the summer of 1985, and its performance was evaluated with data obtained in surveys in the spring of 1986. The system was found to reduce velocity and scour along the bank without changing the energy slope of the channel. Areas of design improvements were identified. The theoretical and experimental background for the design are described briefly. (Author's abstract)
W87-09198

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

ELECTROCHEMICAL ANALYSIS OF ORGANIC POLLUTANTS,
Queen's University, Belfast (Northern Ireland). Dept. of Pharmacy.
W. F. Smyth, and M. R. Smyth.
Pure and Applied Chemistry PACHAS, Vol. 59, No. 2, p 245-256, February 1987. 2 tab, 79 ref.

Descriptors: *Analytical methods, *Pollutant identification, *Electrochemical analysis, *Organic compounds, Pulse polarography, Stripping voltammetry, Trace levels, Sample preparation.

The electroanalytical techniques of pulse polarography, stripping voltammetry and on-line electrochemical detection have been used for the identification and determination of trace concentrations of a wide variety of environmentally significant organic molecules, usually after the application of sample pretreatment procedures, certain separation techniques and, in some cases, derivatisation. Classes of molecules that can be determined using these methodologies are carbonyls, simple aromatics such as nitroaromatics, phenols, polychlorinated aromatics, carboxylic acids, sulfonates, organophosphorus compounds, azomethines, thiols, carbamates and amines. (Author's abstract)
W87-08612

RESEARCH NEEDS FOR RAPID ASSESSMENTS OF CHRONIC TOXICITY,
Kentucky Univ., Lexington. Graduate Center for Toxicology.
For primary bibliographic entry see Field 5C.
W87-08630

MULTISPECIES TESTS: RESEARCH NEEDS TO ASSESS THE EFFECTS OF CHEMICALS ON AQUATIC LIFE,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
J. P. Giesy.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 67-77, 61 ref.

Descriptors: *Water pollution effects, *Multispecies tests, *Research priorities, *Aquatic life, *Chemicals, Pesticides, Aquatic environmental, Toxicity, Hazard assessments, Ecosystems, Xenobiotics.

Aquatic multispecies tests are an extremely flexible and powerful tool in aquatic ecology, especially in the study of the fates and effects of xenobiotics, but are not amenable to the type of protocol development and precision required to be part of a formal hazard assessment scheme. Such methods are completely antithetical to the most efficient use of multispecies test, which is the ability to design a system to elucidate particular mechanisms and interactions in specific ecosystems. One goal of hazard assessment schemes is to remove the subjectivity of individual researchers from the process. Multispecies tests will not achieve this goal. Instead, aquatic multispecies tests of all sizes and configurations should be used by researchers to answer questions posed about the behavior and effects of xenobiotics in aquatic environments. Therefore, rather than designing experiments to test whether multispecies toxicity tests are accurate or replicable they should be used to elucidate mechanisms and make tests of relevant hypotheses within the overall framework of aquatic ecotoxicology. Because of the diversity of interactions among organisms and xenobiotics and the environments on which they exist, one will never be able to absolutely establish the accuracy of multispecies tests. Simply because multispecies tests are more complex does not mean that they are more realistic or have more predictive power than single-species

tests. In fact, they may be more prone to artifacts. There is no evidence to suggest that multispecies toxicity tests, as a class, are more sensitive than the more traditional method of establishing criteria from final chronic values, based on single-species tests. Replicability is a statistical problem rather than an intrinsic property, and appropriate tests and designs are available to determine the relative variability, and therefore the sensitivity of laboratory-scale multispecies test, and they allow the appropriate number of stratified replications to be determined to make the test sufficiently replicable to make precise conclusions. Multispecies test may be more efficient than conducting several single-species tests because of a greater range of sensitivities of test organisms, however, this has not been established. Further research is needed in the area of validation studies of in-situ systems. (See also W87-08624) (Author's abstract)
W87-08632

COMPARISON OF QSAR PREDICTIONS WITH FISH TOXICITY SCREENING DATA FOR 110 PHENOLS,
Environmental Protection Agency, Washington, DC. Office of Pesticides and Toxic Substances.
For primary bibliographic entry see Field 5C.
W87-08637

TIME/TOXICITY RELATIONSHIPS IN SHORT-TERM STATIC, DYNAMIC, AND PLUG-FLOW BIOASSAYS,
SRI International, Menlo Park, CA. Aquatic Toxicology Program.
For primary bibliographic entry see Field 5C.
W87-08639

SENSITIVITY OF CHRONIC ENDPOINTS USED IN DAPHNIA MAGNA STRAUS LIFE-CYCLE TESTS,
Dow Chemical Company, Midland, MI. Mammalian and Environmental Toxicology.
For primary bibliographic entry see Field 5C.
W87-08642

INTERLABORATORY COMPARISON OF THE ASTM BIOCONCENTRATION TEST METHOD USING THE EASTERN OYSTER,
Environmental Protection Agency, Narragansett, RI.
S. C. Schimmel, and R. L. Garnas.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 277-287, 6 tab, 12 ref.

Descriptors: *Oysters, *Water pollution effects, *Comparison studies, Biological magnification, Mollusks, Pentachlorophenol, Trichlorobenzene, Toxicity.

The results of an interlaboratory comparison conducted by four laboratories for bioconcentration factor (BCF) testing using the eastern oyster (Crassostrea virginica) and the organic chemicals pentachlorophenol (PCP), 1,2,4-trichlorobenzene (TCB), and p,p'-DDE are summarized. The bioconcentration test method used was Draft 9 or ASTM Proposed Standard Practice for Conducting Bioconcentration Test with Fishes and Saltwater Bivalve Mollusks. The mean steady state BCFs and high to low BCF ratios (HL ratio) for PCP, TCB, and p,p'-DDE were 64 (2.4), 168 (2.3), and 52,600 (3.4), respectively. The mean high to low ratio for all three chemicals was 2.7, which represents the extreme estimate of variability. The mean H/L ratios for the time to 90% uptake were 6.2 for PCP and 5.8 TCB while the ratio for time to consider 90% depuration for all three chemicals was 3.3. The results were reproducible, considering the varying degrees of experience between participants in conducting BCF tests, the wide geographic distribution between participants, and the different dilution water characteristics. (See also W87-08624) (Author's abstract)
W87-08645

HARMONIZATION OF BIOLOGICAL TESTING METHODOLOGY: A PERFORMANCE-BASED APPROACH,
Environmental Monitoring Systems Lab., Las Vegas, NV.
L. R. Williams.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 288-301, 2 fig, 1 tab, 4 ref.

Descriptors: *Harmonization, *Testing procedures, *Water pollution effects, Data acquisition, Performance evaluation, Data interpretation.

The latitude provided in many written biological test methods, including ASTM standard practices, is such that different laboratories can produce widely varying test results on the same test materials while in technical compliance with the 'method'. One obvious solution to this problem is to standardize upon more tightly controlled, less flexible testing procedures. This approach, while widely accepted in the field of chemistry, has been strongly resisted by the biological testing community. This paper presents an alternative approach to achieving comparability of testing data among laboratories while retaining a high degree of flexibility for the individual laboratory. The keys to this approach are: (1) the development and routine use of standard reference materials for test system calibration and control, (2) the development of 'reference standard methods' that are sufficiently controlled that responses of the test systems to known test materials are predictable and reproducible, and (3) participation in external performance evaluation programs. Recommendations for implementation of a performance-based method evaluation program are offered. (See also W87-08624) (Author's abstract)
W87-08646

APPROPRIATE DURATIONS AND MEASURES FOR CERIODAPHNIA TOXICITY TESTS,
Minnesota Univ., Minneapolis. Dept. of Ecology and Behavioral Biology.
For primary bibliographic entry see Field 5C.
W87-08654

RAPID AQUATIC TOXICITY ASSAY USING INCORPORATION OF TRITIATED-THYMIDINE INTO SEA URCHIN, ARBACIA PUNCTULATA, EMBRYO: EVALUATION OF TOXICANT EXPOSURE PROCEDURES,
JRB Associates, Narragansett, RI. Marine Services Branch.
For primary bibliographic entry see Field 5C.
W87-08655

ACUTE AND CHRONIC TOXICITY TO THE FATHEAD MINNOW, PIMEPHALES PROMELAS, OF EFFLUENTS FROM A TREATMENT PLANT RECEIVING DYE AND PIGMENT PROCESSING WASTEWATER,
Environmental Research Lab.-Duluth, Cincinnati, OH. Newtown Fish Toxicology Station.
For primary bibliographic entry see Field 5C.
W87-08656

BACTERIOLOGICAL QUALITY OF DRINKS FROM VENDING MACHINES,
University Hospital of Wales (Cardiff). Public Health Lab.
For primary bibliographic entry see Field 5F.
W87-08704

ISOLATION OF MUTAGENIC COMPONENTS BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY FROM XAD EXTRACT OF WATER FROM THE NISHITAKASE RIVER, KYOTO CITY, JAPAN,
Institute of Public Health, Kyoto (Japan).
S. Maruoka, S. Yamanaka, and Y. Yamamoto.
The Science of the Total Environment STENDL, Vol. 57, p 29-38, December 1986. 3 fig, 3 tab, 19 ref.

Descriptors: *Isolation, *Mutagens, *Analytical methods, *Chromatography, *Ion exchange, *Nishitakase River, Water pollution, Metabolism, Rivers.

In order to determine the concentrations of mutagenic pollutants in water samples taken from the Nishitakase river in Kyoto City, Japan, the organic fraction was concentrated by XAD adsorption followed by elution with ethyl ether. Salmonella typhimurium tester strains TA1538 and TA98 were used for detecting mutagenic activity. Mutagenic fractions, separated by a liquid-liquid fractionation and two consecutive runs with thin layer chromatography (TLC), were analyzed using high-performance liquid chromatography (HPLC). The results obtained indicated that at least six different frameshift mutagens, all requiring metabolic activation, were present in the river water. Interestingly, all the mutagens isolated showed more pronounced mutagenic activity in TA1538 than in TA98, which is known to be more sensitive for most frameshift type mutagens. (Author's abstract)
W87-08723

USE OF BULLFROGS (RANA CATESBEIANA) AS BIOLOGICAL MARKERS FOR 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN CONTAMINATION IN THE ENVIRONMENT,
National Center for Toxicological Research, Jefferson, AR. Div. of Chemistry.
W. A. Korfmacher, E. B. Hansen, and K. L. Rowland.
The Science of the Total Environment STENDL, Vol. 57, p 257-262, December 1986. 1 fig, 2 tab, 19 ref.

Descriptors: *Rana, *Bioindicators, *Path of pollutants, *Frogs, *Dioxins, *Water pollution effects, Arkansas, Tissue analysis.

Adult bullfrogs were collected along the Rockey Branch Creek in Arkansas. This area is known to be contaminated with 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). The levels of 2,3,7,8-TCDD found in livers from these bullfrogs ranged from 0.64 to 48 ppb. These results suggest the utility of bullfrogs as a biological marker for 2,3,7,8-TCDD in the environment. (Author's abstract)
W87-08733

DETERMINATION OF COBALT, COPPER, MERCURY, AND NICKEL AS BIS(2-HYDROXYETHYL)DITHIOCARBAMATE COMPLEXES BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Department of Energy, Ames, Iowa. Ames Lab.
J. N. King, and J. S. Fritz.
Analytical Chemistry ANCHAM, Vol. 59, No. 5, p 703-708, March 1987. 9 fig, 5 tab, 34 ref.

Descriptors: *Analytical methods, *Cobalt, *Copper, *Mercury, *Nickel, *Chelation, *Chromatography, *Chelating agents, *Chemical analysis, *Pollutant identification, *Sample preparation, *Wastewater analysis, *Water analysis, Reagents, Heavy metals, Solubility, Organic compounds, Adsorption, Solvents, Organic solvents, Detection limits, Wastewater, Industrial wastewater, Performance evaluation, Calibrations.

Ammonium bis(2-hydroxyethyl)dithiocarbamate (HEDC) is used as a precolumn derivatizing reagent for the reversed-phase HPLC determination of Co(II), Cu(II), Hg(II), and Ni(II). The metal-HEDC complexes are soluble in water, which eliminates the need to extract them into an organic solvent prior to analysis. Co(II), Cu(II), and Ni(II) can be determined by direct aqueous injection onto a C18 column in the range of 0.005-10.0 mg/l, with a precision of 1.5-3.2%; detection is at 405 nm. The Hg(II)-HEDC complex is preconcentrated on an on-line adsorption column prior to HPLC analysis. After preconcentration, Hg(II) can be determined in the range of 0.02-25 micrograms/l with a precision of less than 2%. The analysis of spiked electroplating wastewaters showed good agreement with expected values. (Author's abstract)
W87-08831

Group 5A—Identification Of Pollutants

DETERMINATION OF TRACE METALS IN A RIVER WATER REFERENCE MATERIAL BY INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY,
National Research Council of Canada, Ottawa (Ontario). Div. of Chemistry.
D. Beauchemin, J. W. McLaren, A. P. Mykytiuk, and S. S. Berman.
Analytical Chemistry ANCHAM, Vol. 50, No. 5, p 778-783, March 1987. 5 fig, 4 tab, 20 ref.

Descriptors: *Pollutant identification, *Measuring instruments, *Analytical methods, *Chemical analysis, *Water analysis, *Rivers, *Mass spectrometry, *Metals, Heavy metals, Chelation, Chelating agents, Spectrometry, Calibrations, Sample preparation, Performance evaluation, Evaporation, Chemical interference, Sodium, Magnesium, Potassium, Calcium, Aluminum, Copper, Zinc, Nickel, Cadmium, Lead.

The detection power of inductively coupled plasma mass spectrometry (ICP-MS) and its capacity for rapid multielement analysis were demonstrated by the analysis of a riverine water reference material. Fifteen elements (Na, Mg, K, Ca, Al, V, Cr, Mn, Cu, Zn, Sr, Mo, Sb, Ba, and U) were determined directly while five (As, Co, Ni, Cd, and Pb) required a preconcentration prior to analysis, either by evaporation (As) or by chelation by silica-immobilized 8-hydroxyquinoline (Co, Ni, Cd, and Pb). Accurate results were obtained by external calibration, standard additions, or isotope dilution techniques. The method of standard additions generally provides more accurate results than external calibrations, because it compensates for ionization interferences. The isotope dilution technique gives by far the most accurate and precise results, but it requires two isotopes free of isobaric interferences, and equilibration of the spike isotope with the analyte must be achieved in order to assure their identical behavior during any sample treatment preceding the analysis. (Author's abstract)
W87-08832

SPECTROPHOTOMETRIC DETERMINATION OF TRACES OF SILICON IN WATER AFTER COLLECTION AS SILICOMOLYBDENUM BLUE ON AN ORGANIC-SOLVENT-SOLUBLE MEMBRANE FILTER,
Toyama Univ. (Japan). Faculty of Science.
I. Kasahara, R. Terai, Y. Murai, N. Hata, and S. Taguchi.
Analytical Chemistry ANCHAM, Vol. 59, No. 5, p 787-789, March 1987. 3 fig, 4 tab, 24 ref.

Descriptors: *Analytical methods, *Spectrophotometry, *Silicon, *Pollutant identification, *Chemical analysis, *Water analysis, *Silicomolybdenum blue, *Organic solvents, *Membranes, *Filters, *Sample preparation, *Trace elements, Photometry, Solvents, Membrane processes, Filtration, Solubility, Detection limits, Molybdenum, Reagents, Tin, Phosphates, Sodium chloride, Chemical interference.

A rapid and simple preconcentration technique, based on collecting trace elements on a membrane filter and dissolving the membrane filter in an organic solvent, has been applied to the spectrophotometric determination of traces of silicon in water. Silicon, in the range of 1-14 micrograms as SiO2 in 50 ml of water sample, is converted into alpha-silicomolybdic acid and treated with a reductant solution containing tin (IV), L-ascorbic acid, and oxalic acid. The silicomolybdenum blue formed is collected on a nitrocellulose membrane filter in the presence of n-dodecyltrimethylammonium bromide. The membrane and the silicomolybdenum blue are dissolved in 5 ml of dimethylformamide (DMF), and the absorbance due to the silicomolybdate in the DMF is measured at 740 nm against a reagent blank. Phosphate in concentrations similar to that of silicate interferes, but moderate concentrations of arsenate and anionic surfactants and high concentrations of sodium chloride do not interfere. The detection limit is 0.13 micrograms of SiO2 in 50 ml of sample. (Author's abstract)
W87-08833

TREES AS INDICATORS OF SUBTERRANEAN WATER FLOW FROM A RETIRED RADIOACTIVE WASTE DISPOSAL SITE,
Battelle Pacific Northwest Labs., Richland, WA.
W. H. Rickard, and L. J. Kirby.
Health Physics HLTPAO, Vol. 52, No. 2, p 201-206, February 1987. 6 fig, 1 tab, 8 ref. NRC Contract DE-AC06-76RLO 1830.

Descriptors: *Path of pollutants, *Deciduous trees, *Bioindicators, *Radioactive waste disposal, *Monitoring, *Pollutant identification, *Waste disposal, *Groundwater movement, *Path of pollutants, *Heavy water, *Maxey Flats Waste Disposal Site, Indicators, Sampling, Tritium, Trees, Leaves, Maple trees, Oak trees, Chemical analysis, Wells, Kentucky, Forests, Deciduous forests, Wastes, Radioactive wastes.

An investigation was conducted to determine if trees could be used as indicators of subterranean flows of tritiated water into the environment surrounding a shallow-land radioactive waste burial site located in eastern Kentucky (Maxey Flats). Deciduous trees in natural forests on the hillsides downslope from the site were sampled for the presence of tritiated water in the sap of maple trees and in leaf water extracted from oak and hickory trees. Elevated concentrations of H3 were detected in the leaf water from trees 50 m downslope of the western boundary of the fenced exclusion zone. A 3-m-deep well drilled near these trees indicated that the source of tritiated water was a narrow zone of subterranean flow. This flow had not been detected by well-water monitoring alone. It is suggested that a long-lasting (100-yr), water-repellent trench cover be installed at the site to shed rainwater and snow-melt away from the waste-filled trenches. (Author's abstract)
W87-08845

XENOBIOTIC-METABOLIZING ENZYME SYSTEMS IN TEST FISH: I. COMPARATIVE STUDIES OF LIVER MICROSOMAL MONOOXYGENASES,
Istituto Superiore di Sanita, Rome (Italy). Lab. di Tossicologia Comparata ed Ecotossicologia.
For primary bibliographic entry see Field 5C.
W87-08852

INFLUENCE OF CADMIUM EXPOSURE ON SELECTED HEMATOLOGICAL PARAMETERS IN FRESHWATER TELEOST, NOTEMIGONUS CRYSOLEUCAS,
Northeast Louisiana Univ., Monroe. School of Pharmacy.
For primary bibliographic entry see Field 5C.
W87-08857

COMPARATIVE METABOLISM OF FENITROTHION IN AQUATIC ORGANISMS: I. METABOLISM IN THE EURYHALINE FISH, ORYZIAS LATIPES AND MUGIL CEPHALUS,
Sumitomo Chemical Co., Ltd., Takarazuka (Japan). Takarazuka Research Center.
For primary bibliographic entry see Field 5B.
W87-08859

COMPARATIVE METABOLISM OF FENITROTHION IN AQUATIC ORGANISMS: II. METABOLISM IN THE FRESHWATER SNAILS, CIPANGOPALUDINA JAPONICA AND PHYSA ACUTA,
Sumitomo Chemical Co., Ltd., Takarazuka (Japan). Takarazuka Research Center.
For primary bibliographic entry see Field 5B.
W87-08860

COMPARATIVE METABOLISM OF FENITROTHION IN AQUATIC ORGANISMS: III. METABOLISM IN THE CRUSTACEANS, DAPHNIA PULEX AND PALAEMON PAUCIDENS,
Sumitomo Chemical Co., Ltd., Takarazuka (Japan). Takarazuka Research Center.
For primary bibliographic entry see Field 5B.
W87-08861

USE OF THE POCKETBOOK MUSSEL, LAMPSILIS VENTRICOSA, FOR MONITORING HEAVY METAL POLLUTION IN AN OZARK STREAM,
Missouri Department of Conservation, Columbia.
J. M. Czarnezki.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 4, p 641-646, April 1987. 1 fig, 3 tab, 13 ref.

Descriptors: *Water pollution sources, *Mussels, *Bioindicators, *Monitoring, *Heavy metals, *Streams, *Mine wastes, *Big River, Missouri, Lead, Catchment areas, Cadmium, Tissue analysis, Mollusks, Sediments, Indicators, Pollutant identification.

A study was undertaken to determine which tailings ponds are the major sources of heavy metals in Big River in the 'lead belt' of southeastern Missouri using 36 caged pocketbook mussels (Lampsilis ventricosa). Whole-body tissues were analyzed by graphite furnace atomic absorption. Lead and cadmium concentrations increased in water, sediment, and mussel tissue with a downstream progression. The increase in lead and cadmium in tissue was significant only at stations 3, 4, and 5, which are affected by abandoned mining sites, and at station 2, where lead was significantly higher after an 8-week exposure. The highest concentrations of lead (74.2 micrograms/g) and cadmium (11.3 micrograms/g) occurred at station 5 after a 12-week exposure. It is concluded that the main sources of heavy metals contamination in Big River are from the Desloge tailings pond and ponds and chat piles within the Flat River drainage basin. The mussels worked very well for the study and should work in similar studies as well. (Doria-PTT)
W87-08875

STATISTICAL ASSESSMENT OF A SAMPLING PATTERN FOR EVALUATION OF CHANGES IN MERCURY AND ZINC CONCENTRATIONS IN PATELLA COERULEA,
Institut National de la Sante et de la Recherche Medicale, Nice (France).
D. Puel, N. Zsurger, and J. P. Breittmayer.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 4, p 700-706, April 1987. 5 tab, 25 ref.

Descriptors: *Limnology, *Statistical analysis, *Mercury, *Zinc, *Bioaccumulation, *Tissue analysis, *Patella, *Sampling, *Marine environment, *Path of pollutants, Heavy metals, Accumulation, Mollusks, Water pollution, Coasts, Environment, Shellfish, Chemical analysis, Water analysis, Analysis of variance, Biological magnification, Pollutant identification.

Sampling patterns were evaluated statistically for levels in limpets (Patella coerulea) of two metals: mercury, which is toxic and plays no part in any natural metabolic process, and zinc, which is required in low concentrations by certain enzyme systems. Mercury was measured by cold vapor atomic absorption, and zinc by anodic redissolution. Six sets of means and ranges for the three parameters studied (wet weight, mercury content, and zinc content) are reported, and and an analysis of variance was conducted. A minimum of about 20 individuals were required to calculate means with a 5% confidence interval. Correct evaluation of mercury contamination in the limpet was found to depend on the total amount taken up and not on its concentration, which is the usual parameter. It is concluded that: (1) strict grid-mapping of the site is essential; (2) prior consideration must be given to grading the organism by size to ensure significant results; and (3) account must be taken of mollusk weight, since its changes may appreciably influence the fluctuation of some metal values. (Doria-PTT)
W87-08884

METAL-BINDING PROTEIN IN THE PACIFIC OYSTER, CRASSOSTREA GIGAS: ASSESSMENT OF THE PROTEIN AS A BIOCHEMICAL ENVIRONMENTAL INDICATOR,
C. B. Research International Corp., Sidney (British

Columbia).
B. E. Imber, J. A. J. Thompson, and S. Ward.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 4, p 707-714, April 1987. 2 fig, 2 tab, 14 ref. IRAP Grant D2817.

Descriptors: *Chelation, *Proteins, *Oysters, *Bioindicators, *Pollutant identification, *Monitoring, *Heavy metals, *Bioaccumulation, Indicators, Copper, Zinc, Cadmium, Mollusks, Water pollution effects, Limnology, Vancouver Island, British Columbia, Accumulation, Tissue analysis, Chromatography, Polarographic analysis, Statistical analysis, Analysis of variance, Monitoring.

A simple, cost-effective method was devised for quantifying metal-binding proteins (MBP) in the Pacific oyster (Crassostrea gigas) for possible use as a bioindicator. Oysters were collected from four locations on Vancouver Island, BC. Thiolic proteins were determined using modified differential pulse polarography. The concentrations of MBP and Cu, Cd, and Zn from digestive gland tissue of oysters are presented. Protein ranged from 7.18 g/kg dry weight at the Crofton outfall site near a kraft pulp mill to 5.02 g/kg at Yellow Point, one of two reference sites. Statistical analysis using ANOVA and the SNK test for differences of means indicated significant differences were established at the p = 0.01 level between the experimental and reference sites. Copper and cadmium appear to be associated with a polarographically active protein fraction at about 20,000 Da. The major metal-binding component is probably a copper protein, with a structure possibly similar to a dimeric metallothionein. The major result of this study is the relationship found to exist between the MBP or cytosolic metal concentrations and sites of collection. It is concluded that, while environmental factors such as salinity and bed-substrate could be invoked to explain these statistically significant differences, the data can more readily be interpreted to reflect differences in environmental exposure to copper. (Doria-PTT)
W87-08885

CORRELATION BETWEEN HEAVY METAL ACUTE TOXICITY VALUES IN DAPHNIA MAGNA AND FISH,
Industrial Toxicology Research Centre, Lucknow (India).
B. S. Khangarot, and P. K. Ray.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 4, p 722-726, April 1987. 1 fig, 3 tab, 15 ref.

Descriptors: *Bioindicators, *Heavy metals, *Toxicity, *Daphnia, *Bioassay, *Water pollution effects, *Trout, Crustaceans, Assay, Fish, Cadmium, Lead, Copper, Silver, Nickel, Tin, Chromium, Zinc, Regression analysis, Physicochemical properties, Hard water.

The acute toxicity of various heavy metals to Daphnia magna was determined for 48 h exposure and compared to existing LC50 values for rainbow trout. The order of toxicity of tested ions to Daphnia was: Hg, Ag, Cu, Zn, Cr = Cd = Pb. The order of toxicity of ions to rainbow trout was: Ag = Hg, Cu, Zn, Cd, Pb, Cr, Ni. A strong correlation between Daphnia and rainbow trout acute toxicity values was evident for eight ions. Regression analysis suggests a good correlation; r squared = 0.814 for straight line equation. It is theoretically possible to calculate acute toxicity values for rainbow trout using the regression equation. It is concluded that the acute toxic responses of Daphnia are strongly correlated to the LC50 of fish, so that the screening of metal compounds might well be done using D. magna. The correlation obtained in this study might have been still more positive if water of comparable hardness had been used for the two studies. (Doria-PTT)
W87-08887

COMPLETE HF DIGESTION METHOD FOR ELEMENT AND TRACE ELEMENT DETERMINATION IN SOILS, SEDIMENTS, SLUDGES AND OTHER SIMILAR SAMPLES USING A CLOSED SYSTEM (HF-TOTALAUFSCHLUSS IM GESCHLOSSENEN SYSTEM FUR ELEMENT- UND SPURENELEMENTBESTIMMUNGEN IN BODEN, KLARSCHLAMM, SEDIMENTEN U. A. PROBEN),
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Oekologische Chemie.
P. Schramel, G. Lill, and R. Seif.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 326, No. 2, p 135-138, January 1987. 12 tab, 3 ref.

Descriptors: *Digestion, *Trace elements, *Chemical analysis, *Soil analysis, *Sludge, *Sediments, *Analytical methods, *Hydrofluoric acid, *Heavy metals, Silicates, Contamination, Aluminum, Cadmium, Chromium, Copper, Manganese, Pollutant identification, Lead, Nickel, Zinc, Iron.

A modified system is described for a complete HF-ashing technique for silicate matrices such as soils, sediments, and sludges, based on a pressure ashing device described elsewhere. Using graphite-fortified PTFE sample containers, it is possible to apply a mixture of HNO3/HF for ashing in the closed pressure ashing apparatus. The technique was tested with several standard reference materials. The new system has the advantage of a considerable saving of time and freedom of contamination, and element losses compared to open techniques. (Author's abstract)
W87-08894

RESEARCH IN ENVIRONMENTAL POLLUTION: II. DETERMINATION OF POLYCHLORINATED NITROBENZENES (PCNB'S) IN MAIN RIVER FISH,
Hessische landwirtschaftliche Versuchsanstalt, Darmstadt (Germany, F. R.).
H. Steinwandter.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 326, No. 2, p 139-141, January 1987. 2 fig, 1 tab, 5 ref.

Descriptors: *Analytical methods, *Limnology, *Pollutant identification, *Rhine River, *Fish, *Tissue analysis, *Chlorinated hydrocarbons, *Electron capture gas chromatography, *Mass spectrometry, Sample preparation, Reagents, Chromatography, Gas chromatography.

Twelve polychlorinated nitrobenzene compounds were identified in fish from the Main River, Germany, using gas chromatography (ECD), mass spectroscopy, and mass fragmentography. The ECD chromatogram of fish extract was very complex, making identification difficult. Therefore, all non-polar compounds including PCBs were separated on a 2 g florisil column in the first 15 ml fractions with hexane. The remaining polar compounds were then eluted in the following 10 ml fraction with toluene. This fraction also produced a very complex chromatogram, indicating many accumulated polar compounds in Main fish. Certain peaks were identified as PCNBs, 6-chloro-2-nitrotoluene, and 4-chloro-2-nitrotoluene. (Author's abstract)
W87-08895

ANALYSIS OF PENTACHLOROPHENOL IN WATER AND URINE BY ENRICHMENT WITH LIPIDEX(R) 5000,
Karolinska Inst., Stockholm (Sweden). Dept. of Physiological Chemistry.
K. Noren, and J. Sjovall.
Journal of Chromatography JOCRAM, Vol. 414, No. 1, p 55-63, February 1987. 2 fig, 6 tab, 24 ref. Swedish Medical Research Council Grant 03X-219.

Descriptors: *Analytical methods, *Pentachlorophenol, *Water analysis, *Chemical analysis, *Urine, *Gels, *Sample preparation, Pollutant identification, Pesticides, Phenolic pesticides, Halogenated pesticides, Hydrocarbons, Chlorinated hydrocarbons, DDT, Electron capture gas chromatography, Contamination, Chromatography, Gas chromatography, Solvents, Reagents, Mass spectrometry.

A method is described for using the lipophilic gel Lipidex (R) 5000 for sorption of pentachlorophenol (PCP) from water and urine. The procedure for water gives a simultaneous clean-up from lipophilic contaminants and also permits the determination of less polar compounds such as p,p'-DDT and TCDD collected in a separate fraction. The extracted PCP is derivatized to PCP acetate, which is determined by electron capture gas chromatography. Average recoveries were: PCP 96%, DDT 95%, and TCDD 92%. A similar method for enrichment of PCP was applied to urine, with average recoveries of 92% for PCP (non-hydrolyzed urine) and 96% (hydrolyzed urine). The analyses indicate that PCP in urine from non-occupationally exposed persons is originally conjugated and to some extent liberated when stored. The contamination of organic solvents and the laboratory environment with PCP is discussed. (Author's abstract)
W87-08896

IMPACT-SENSITIVENESS OF SOIL ORIBATID SPECIES TO THE WASTE WATER FROM A COAL DISTILLATION PLANT,
Calcutta Univ. (India). Dept. of Life Science.
T. Bhattacharya, and J. Bhattacharya.
Entomon ENTOD5, Vol. 10, No. 4, p 267-270, December 1985. 1 fig, 1 tab, 7 ref.

Descriptors: *Bioindicators, *Water pollution effects, *Mites, *Industrial wastewater, *Ecological effects, *Soil environment, Wastewater, Environment, Indicators, Ammonia, Phenols, Sulfides, Cyanide, Ecology, Density, Population density.

The dominance status of various oribatid species in polluted and unpolluted sites were compared. The polluted site was a field polluted by industrial wastewater containing such substances as ammoniacal nitrogen, phenol, sulfides, and cyanide. Out of 55 species, 33 were found in the polluted site and 49 in the unpolluted site. Out of 27 species present in both sites, no change in dominance status was found for 21 (5 dominant and 16 rare). There was a noticeable shift in the dominance status for many species, however. Scheloribates fimbriatoides suffered a 97.4% reduction in abundance at the polluted site, while Xylobates indicus and Galumna flabellifera experienced 2133% and 427% increases in abundance, respectively. It is concluded that these three species can be used as bioindicators of environmental stress or pollution. (Author's abstract)
W87-08898

SEASONAL DISTRIBUTION OF LEGIONELLAE ISOLATED FROM VARIOUS TYPES OF WATER IN ISRAEL,
Hebrew Univ.-Hadassah Medical School, Jerusalem (Israel). Dept. of Clinical Microbiology.
H. Bercovier, B. Fattal, and H. Shuval.
Israel Journal of Medical Sciences IJMDAI, Vol. 22, No. 9, p 644-646, September 1986. 1 tab, 12 ref.

Descriptors: *Seasonal variation, *Legionella, *Water analysis, *Israel, *Limnology, *Surface water, *Potable water, *Fish ponds, *Oxidation ponds, Ponds, Microbiological studies, Bacteria, Pathogenic bacteria, Diseases, Human diseases, Sampling, Monitoring, Irrigation water, Public health, Epidemiology, Surveys, Culturing techniques.

The presence of legionellae was investigated over 2 years in various types of water in Israel. Potable water, fish ponds, oxidation ponds, and surface water were sampled monthly. Legionellae were not isolated during the cold months (November to April), but were continually isolated during the rest of the year. Of 56 water sources, 19 were found culture-positive for Legionella pneumophila serogroups 1, 2, 3, 4, and 6, L. bozemanii, L. israelensis, and some nonspeciated Legionella. Since irrigation water in Israel originates from the various types of water found to be culture-positive for Legionella, the public health significance of this finding were correlated with a previous seroepidemiological survey of irrigation workers. (Author's abstract)
W87-08903

'SPRAY-COLUMN' LABORATORY APPARATUS FOR ORGANIC MATTER EXTRACTION FROM SLUDGES,
Stazione Sperimentale per l'Industria delle Pelli e delle Materie Concianti, Naples (Italy).
G. Grasso, and G. Bufalo.
Journal of Environmental Science and Health (A) JESEDU, Vol. 22, No. 1, p 47-57, January 1987. 2 fig, 3 ref.

Descriptors: *Analytical methods, *Measuring instruments, *Liquid-liquid extractors, *Sludge, *Design standards, *Spray-columns, Volatile organic compounds, Petroleum, Extraction, Temperature.

The design of a laboratory apparatus for application to continuous liquid-liquid extraction of organic matter from sludges is discussed. It is based on the 'spray-tower' industrial plant principle, and it is suitable also for high volatile solvents as light petroleum. In this way it was possible to overcome typical disadvantages showed by traditional extracting devices and methodologies, such as incomplete recovery, thermal degradation, foam forming and tedious manipulations. (Author's abstract)
W87-08913

EFFECT OF STORAGE ON THE DISTRIBUTION OF TRACE ELEMENTS (LEAD, CADMIUM, COPPER, ZINC AND MERCURY) IN NATURAL WATER,
An-Najah N. Univ., Nablus (Israel). Chemistry Dept.
R. Salim.
Journal of Environmental Science and Health (A) JESEDU, Vol. 22, No. 1, p 59-69, January 1987. 5 fig, 9 ref.

Descriptors: *Sample preservation, *Analytical methods, *Heavy metals, *Trace elements, *Natural waters, Containers, Ions, Metals, Lead, Cadmium, Copper, Zinc, Mercury.

The effect of storage on the distribution of trace elements (lead, cadmium, copper, mercury, and Zinc) has been studied. Relations between the percentage of metal ion present as adsorbed on container surface, as adsorbed on the suspended particles, and as free ions in solution and time of storage in glass bottles have been constructed for the five metals. A method for determining the distribution of trace elements between solution and the suspended particles in the undisturbed natural water in its source has been developed using experimental values of the distribution of these elements in a collected sample analyzed in the laboratory. (Author's abstract)
W87-08914

ENVIRONMENTAL SPECIMEN BANK SPECIFIC REFERENCE MATERIALS - MAIN AIMS AND PREPARATION,
Nuclear Research Center (KFA) Julich GmbH (Germany, F.R.). Inst. of Applied Physical Chemistry.
M. Stoeppler, F. Backhaus, J. D. Schladot, and N. Commerscheidt.
Fresnius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 326, No. 7, p 707-711, April 1987. 1 fig, 3 tab, 26 ref.

Descriptors: *Reference standards, *Environmental specimen bank, Sample preparation, Germany, Analytical methods, Standards.

Following an introduction into the principle of an environmental specimen bank the philosophy of production and application of lyophilized and fresh reference materials on the basis of surplus materials of the environmental specimen bank (ESB) in the Federal Republic of Germany or very similar materials is discussed. Subsequently a description is given on the preparation and characterization of these materials and some examples of their properties and commencing application within current analytical characterization studies of materials stored in the ESB. (Author's abstract)
W87-08918

AMMONIUM BICARBONATE-DTPA AND DTPA EXTRACTIONS OF SLUDGE-AMENDED SOILS,
Colorado State Univ., Fort Collins. Dept. of Agronomy.
K. A. Barbarick, and S. M. Workman.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 2, p 125-130, April-June 1987. 1 fig, 7 tab, 22 ref.

Descriptors: *Path of pollutants, *Bioaccumulation, *Analytical methods, *DTPA, *Ammonium bicarbonate, *Extraction, Field tests, Soil properties, Heavy metals, Nutrients.

The objective of this study was to compare the standard DTPA soil test method with the ammonium bicarbonate (AB-DTPA) procedure and to correlate extractable levels with elemental concentration in leaf of Swiss chard grown in the greenhouse and in the grain and straw of hard red winter wheat grown in the field. For the greenhouse study, sewage sludges containing low metal content were added to Nunn clay loam and Redfeather loamy sand at rates ranging from 0 to 120 Mg dry sludge/ha in 15 Mg/ha increments. Coefficients of correlation for the greenhouse study between AB-DTPA and plant concentrations of Cd, Cu, Ni, and Zn in Swiss chard were > 0.90 for the calcareous soil (Nunn) and > 0.93 (except for Cu) for the acidic soil (Redfeather). Even though DTPA extracted less Cd, Cu, Ni, Pb, and Zn than AB-DTPA, the r values between these two extractants were > 0.98 for each metal. For the field studies involving addition of a low metal sludge from Littleton/Englewood, CO, to four sets of plots from 1982 to 1985, only the DTPA levels of Zn correlated significantly with the associated grain concentration. In contrast, AB-DTPA provided significant correlations between soil levels and concentrations of Cd and P in straw and the Ni in the grain. The field studies indicate that when a low metal sludge is applied at rates consistent with N needs of the crop, levels of AB-DTPA extractable Zn and possibly Pb should indicate the potential for Zn and Pb uptake into wheat. Because the concentrations of Cd, Cu, and Ni in the sludge applied did not result in plant uptake at levels that were significantly different from those in the untreated control, nonsignificant correlations were found. Also, AB-DTPA extraction of soils showed that adequate P was present so that no response to the P added with the sludge was expected. For the field study, the r values between AB-DTPA and DTPA were > 0.95 for each metal. The results indicate that AB-DTPA is as valid as, if not superior to, DTPA for metal extraction and offers the additional advantage in allowing nutrient analysis if one wants to assess both plant nutrients and trace metals. (Author's abstract)
W87-08923

CHEMISTRY OF TENSION LYSIMETER WATER AND LATERAL FLOW IN SPRUCE AND HARDWOOD STANDS,
Tennessee Valley Authority, Muscle Shoals, AL. Air Quality Branch.
For primary bibliographic entry see Field 5B.
W87-08926

THYMIDINE INCORPORATION AND MICROBIAL RESPIRATION IN THE SURFACE SEDIMENT OF A HYPEREUTROPHIC LAKE,
Uppsala Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 2H.
W87-08936

OCCURRENCE, SIGNIFICANCE, AND DETECTION OF KLEBSIELLA IN WATER SYSTEMS,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
E. E. Geldreich, and E. W. Rice.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 5, p 74-80, May 1987. 4 tab, 76 ref.

Descriptors: *Klebsiella, *Pollutant identification, *Water supply, *Public health, *Analytical methods, Bacteria, Detection, Filtration.

Widespread occurrences of Klebsiella in water distribution networks have resulted in much discussion about this organism's effect on public health and about action that should be taken when Klebsiella is detected in public water supplies. Results obtained during development and testing of an improved medium for detecting Klebsiella showed that the medium (M-Kleb) has excellent differentiating characteristics and an average recovery rate of 94 percent for Klebsiella. This medium can also be used as a supplement streak plate to demonstrate the presence of Klebsiella during membrane filter coliform verification or during the multiple-tube confirmation process. (Author's abstract)
W87-08958

CONCENTRATIONS OF MERCURY IN NEAR SHORE SURFACE WATERS OF THE BAY OF BISCAY AND IN THE GIRONDE ESTUARY,
Institut Francais de Recherche pour l'Exploitation de la Mer, Nantes (France).
D. Cossa, and J. Noel.
Marine Chemistry MRCHBD, Vol. 20, No. 4, p 389-396, March 1987. 2 fig, 2 tab, 19 ref.

Descriptors: *Pollutant identification, *Mercury, *Surface water, *Bay of Biscay, *Gironde Estuary, Turbidity, Salinity, Distribution.

Total and reactive mercury concentrations have been measured on samples of surface water taken along the shores of the Bay of Biscay and in the Gironde Estuary. In the low turbid areas of the Bay of Biscay the average concentration of total mercury of unfiltered samples is $3.5 + \text{or} - 0.7$ ($n = 15$) and the reactive mercury $2.1 + \text{or} -0.7$ ($n = 12$) pmol/L; the high levels, up to 27.6 (total mercury) and 4.6 (reactive mercury) pmol/L are from the most turbid samples taken from the Marennes-Oleron basin. In the Gironde Estuary, the distribution of total dissolved mercury rises to a peak of concentration (38 pmol/L) within the high turbidity zone where the salinity is lower than 10%. The possible origin of this pattern of distribution is discussed. (Author's abstract)
W87-08961

ACCURACY OF SELECTIVE EXTRACTION PROCEDURES FOR METAL SPECIATION IN MODEL AQUATIC SEDIMENTS,
New Hampshire Univ., Durham. Dept. of Chemistry.
C. Kheboian, and C. F. Bauer.
Analytical Chemistry ANCHAM, Vol. 59, No. 10, p 1417-1423, May 1987. 7 fig, 1 tab, 36 ref.

Descriptors: *Extraction, *Analytical methods, *Trace metals, *Speciation, *Water analysis, *Sediments, *Model studies, Adsorption, Phase association, Heavy metals.

The interpretability of a selective extraction procedure for metals in aquatic sediments was tested by means of synthetic models. The major sedimentary geochemical phases were prepared and characterized by X-ray diffraction and scanning electron microscopy. A specific trace metal was doped into each phase by adsorption or coprecipitation, content being verified by atomic absorption (AA). The phases and metals were calcite (Pb), iron sulfides (Zn), humic acid (Cu), and iron oxyhydroxides (Cu or Ni). Three different model sediments were prepared by combining phases and diluting with silica or illite. Measurements of extracts by AA and inductively coupled plasma (ICP) indicated that trace metals were not recovered in the appropriate fractions. This implies that 'selective extraction' procedures as currently practiced may not be suitable for distinguishing the phase-association of metals in real sediments. (Author's abstract)
W87-08985

DETERMINATION OF LOW LEVELS OF CATIONIC POLYELECTROLYTES IN WATER,
Petrolite Corp., St. Louis, MO.
D. P. Parazak, C. W. Burkhardt, and K. J. McCarthy.
Analytical Chemistry ANCHAM, Vol. 59, No. 10, p 1444-1445, May 1987. 3 fig, 17 ref.

Descriptors: *Water analysis, *Cations, *Polyelectrolytes, *Analytical methods, Anions, Dyes, Colloids, Spectral analysis, Sample preparation.

Anionic dye complexation has been used to measure the concentrations of cationic polyelectrolytes in water. The colloidal form of the complex interferes with spectrophotometric measurements and must be removed. Advantage is taken of the natural hydrophobic character of the complex to facilitate its removal with Freon. (Author's abstract)
W87-08986

SYSTEMATIC APPROACH TO ADSORPTION ON XAD-2 RESIN FOR THE CONCENTRATION AND ANALYSIS OF TRACE ORGANICS IN WATER BELOW THE (MU)G/L LEVEL,
Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
B. Wigilius, H. Boren, G. E. Carlberg, A. Grimvall, and B. V. Lundgren.
Journal of Chromatography JOCRAM, Vol. 391, No. 1, p 169-182, March 1987. 5 fig, 2 tab, 29 ref.

Descriptors: *Adsorption, *Analytical methods, *Ion exchange, *Trace levels, *Detection limits, *Organic compounds, Performance evaluation, Solvents, Optimization, Desorption.

The adsorption on XAD-2 resin of trace organics in water has been optimized and evaluated step-by-step at concentration levels below 1 microgram/L and in the presence of organic substances that may interfere with the adsorption. Two solvent sequences, methanol-diethyl ether-water (sample) and methanol-acetone-water (sample), gave satisfactory blank levels without reducing the adsorption capacity. Separate studies of the adsorption, desorption and evaporation steps showed that for a great number of non-polar compounds with different functional groups the recovery was mainly limited by losses in the evaporation step. For polar compounds such as certain alcohols and phenols the adsorption efficiency was the most critical factor. Losses during the desorption step could be made negligible except for naphthalene and anthracene. A study of interaction effects between humic substances in the water sample and the low-molecular-weight compounds to be analyzed by gas chromatography did not give any evidence of a decrease in recovery or increase in breakthrough for any of the surface-water samples. Comparisons with dichloromethane extraction and stripping enrichment showed that adsorption on XAD-2 can give blank levels and recoveries which are in some respects superior. Furthermore, the XAD-2 technique and dichloromethane extraction were less sensitive to interaction effects from humic substances and less sensitive to interaction effects from humic substances and less sensitive than the stripping technique. (Author's abstract)
W87-09011

GAS CHROMATOGRAPHIC ANALYSIS OF VOLATILE COMPOUNDS IN WATER AND BIOLOGICAL SAMPLES WITH AN AUTOMATIC INJECTOR,
C. H. U., Angers (France). Lab. de Pharmacologie.
For primary bibliographic entry see Field 7B.
W87-09012

IMPLICATIONS OF ELEMENTAL CHARACTERISTICS OF HUMIC SUBSTANCES,
Arizona Univ., Tucson. Dept. of Chemistry.
For primary bibliographic entry see Field 7B.
W87-09084

IMPROVED MONITORING TECHNIQUES TO ASSESS GROUNDWATER QUALITY NEAR SOURCES OF CONTAMINATION,
Environmental Monitoring Systems Lab., Las Vegas, NV.
G. E. Schweitzer.
IN: Safe Drinking Water: The Impact of Chemicals on a Limited Resource. Lewis Publishers, Chelsea, Michigan. 1985. p 167-175.

Descriptors: *Groundwater pollution, *Monitoring, *Water quality control, *Water pollution sources, *Pollutant identification, Groundwater management, Drinking water, Aerial photography, Groundwater mining, Aquifers, Sampling, Water pollution control, Public health, Lasers.

Much of the information about groundwater quality has come from monitoring surveys of contaminants entering drinking water systems that use groundwater and surveys of contaminants in tap water that is drawn from individual wells. A second approach to assessing groundwater quality is to examine all available monitoring data about an aquifer, identify contaminant sources of the aquifer and hydrogeological conditions of the area, and then attempt to characterize the quality of the aquifer. A third approach is monitoring near the sources of groundwater comtamination. The Resource Conservation and Recovery Act (RCRA) and the Superfund legislation are a major impetus for increased groundwater protection efforts. Aerial photography has been a very valuable tool in identifying, characterizing, and cataloging sites. Progress is being made in adapting several surface geophysical techniques developed primarily for oil and mineral exploration to the identification of inorganic contaminant plumes in groundwater. Geostatistics have found increasing receptivity in efforts to characterize the areal extent of surface soil comtaination near point sources of pollution. Field screening techniques now are bieng used for detecting volatile organic compounds and halogenated pesticides which are associated with many hazardous waste sites. The use of fiber optics technology in combination with laser fluorescence spectroscopy as a means for detecting groundwater contaminants in the field has attracted considerable attention in recent months. Under the RCRA the current approach of groundwater monitoring calls for detection monitoring to determine whether contaminants reach the groundwater, and compliance monitoring to determine whether prescribed levels of a pollutant are being exceeded. Monitoring requirements at Superfund sites are less well defined, given the wide variety of situations that are encountered. (See also W87-09114) (Geiger-PTT)
W87-09126

NBS ENVIRONMENTAL STANDARD REFERENCE MATERIALS FOR USE IN VALIDATING WATER ANALYSIS,
National Bureau of Standards, Washington, DC. Office of Standard Reference Materials.
R. Alvarez.
IN: Safe Drinking Water: The Impact of Chemicals on a Limited Resource. Lewis Publishers, Chelsea, Michigan. 1985. p 177-182.

Descriptors: *Water analysis, *Pollutant identification, *Inorganic compounds, *Organic compounds, *Standards, Calibrations, Gas chromatography, Trace elements, Aromatic compounds, Hydrocarbons, Phenols.

The National Bureau of Standards issues Standard Reference Materials (SRMs) certified for concentrations of important inorganic and organic priority pollutants for use in calibrating instrumentation and validating experimental data and methods. Three water SRMs are available for inorganic contaminants. They are: SRMs 1641b and 1642b certified for mercury at the microgram/milliliter and nanogram/milliliter levels, respectively, and SRM 1643a certified for 17 trace elements. Three SRMs have been issued for organic pollutants. They are: SRM 1644, Generator Columns for Polynuclear Aromatic Hydrocarbons; SRM 1647 Priority Pollutant Polynuclear Aromatic Hydrocarbons (in Acetonitrile); and SRM 1639, Halocarbons (in Methanol) for Water Analysis. Other SRMs being developed are an SRM for the concentrations of approximately ten phenols in methanol and an SRM for use with combined gas chromatography/mass spectrometry. The latter development will consist of two solutions: one for the concentrations of approximately ten priority pollutants; the other for the concentrations of the same compounds which have been labeled isotopically. The compounds will represent acid extractable, base-neutral extractable, and volatile classes. Copies of SRM 1639 and SRM 1643a are appended to the paper. (See also W87-09114) (Geiger-PTT)
W87-09127

CHEMISTRY OF NATURAL WATERS,
For primary bibliographic entry see Field 2K.
W87-09149

REGULATORY IDENTIFICATION OF PETROLEUM HYDROCARBONS IN DREDGED MATERIAL,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. U. Clarke, and A. B. Gibson.
Proceedings of a Workshop. Miscellaneous Paper D-87-3, March 1987. Final Report. 83 p, 4 fig, 1 tab, 8 ref, 3 append.

Descriptors: *Pollutant identification, *Hydrocarbons, *Dredging, Aromatic hydrocarbons, Sediment analysis, Chemical analysis, Bioaccumulation.

A 3-day workshop on the regulatory evaluation of petroleum hydrocarbons in dredged material was conducted 13-15 May 1986 at the US Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi. The workshop format consisted of brief topic introductions by each participant, followed by roundtable discussions. The discussions culminated in the recommendation of specific hydrocarbon compounds and the development of a suggested tiered testing approach for regulatory evaluation of hydrocarbon-contaminated dredged material. The compounds selected were 15 priority pollutant polycyclic aromatic hydrocarbons: acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene. The tiered testing approach consisted of first-tier acute toxicity tests and sediment analysis for the key hydrocarbons, followed by second-tier 10-day bioaccumulation tests. Other classes of hydrocarbons and biological tests were recommended for further research, with possible future inclusion in the evaluation scheme. (Lantz-PTT)
W87-09154

SAMPLING AND COMPOSITION OF THE SURFACE MICROLAYER,
Anne Arundel Community Coll., Arnold, MD.
H. Gucinski, and, D. W. Goupil, and R. E. Baier.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 165-180, 9 fig, 20 ref.

Descriptors: *Water sampling, *Water surface profiles, *Chemical analysis, *Sampling methods, Film sampling, Lipids, Proteins, Fatty acids, Biodegradation.

Of the several sampling methods employed that address the specific question of the nature of organic matter at the water surface, three techniques in particular have been used so extensively that the bulk of the reported measurements can be taken as 'representative' findings. They are: (1) the screen dipping technique, in which a metal screen supported by a suitable frame is horizontally touched to the water interface, and the sample is then drained into the collecting bottle by tilting the frame; (2) the Harvey 'bull roller', in which a buoyant, ceramic cylinder is 'rolled' along the water surface, collecting surfactants by the high hydrophilicity of the clean ceramic surface, and the accumulated sample is wiped onto or into the sample bottle; and (3) a process in which a highly polished metal surface is dipped vertically through the interphase, thereby transferring surfactant organics from the microlayer and 'anchoring' the hydrophilic moieties to the high-surface-energy metal surface during the retrieval of the metal sheet or prism. The results of this study suggest a number of additional experiments that will have a bearing on obtaining quantitative relationships concerning the film sampling of surfactant mixture likely to be found at sea. First a series of monolayers of a single surfactant, lipid or protein, would be formed for a range of increasing sea-salt concentrations, simulating the changes found in an

estuary as one proceeds from the headwaters to the open ocean. Sampling the films at different surface pressures will provide important information about the effect of salt on the transference and adhesion of proteins and lipids to the metal prism surface. Another experiment might be to take sea water, where prism dips confirm the dominant protein fraction along with the absence of lipids or lipid-like materials, and conduct prism dips after known quantities of fatty alcohols of lipids have been added. Finally, some extensive studies of natural films also might be conducted, particularly with regard to the possibly changing film composition with surfactant film age and under naturally varying surface pressure regimes. Biological conversion of organic materials must also be considered as an integral part of the dynamics of microlayer processes. (Lantz-PTT)
W87-09173

THEORY OF FLUORESCENT IRRADIANCE FIELDS IN LAKES AND SEAS,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
R. W. Preisendorfer.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as PB87 196465, A12 in paper copy, A01 in microfiche. NOAA Technical Memorandum ERL PMEL-70, March 1987. 249 p, 9 fig, 18 ref.

Descriptors: *Analytical methods, *Irradiance, *Lakes, *Seawater, *Fluorescence, Chlorophyll, Organic matter, Optical properties.

It is shown how to determine the irradiance field in lakes and seas that have fluorescing stratified layers of chlorophyll and other organic material. This is the direct solution of the irradiance field which starts from the depth-distribution of optical properties, in particular the spectral absorption and scattering functions of the material. Conversely, it is shown how to determine these optical properties, from irradiance probe measurements in situ, by inverting the direct solutions for the irradiance field. The present work forms the basis for applications of radiative transfer theory to remote sensing of seas and lakes and specifically for optically-based chlorophyll assays within such media. In particular, it is shown how to determine the intrinsic (or specific) optical properties of a natural hydrosol from irradiance measurements in the hydrosol. (Author's abstract)
W87-09193

CONCENTRATION OF GIARDIA CYSTS FROM WATER BY A CENTRIFUGAL CREAM SEPARATOR,
State Univ. of New York, Cobleskill. Dept. of Biological and Physical Sciences.
E. P. Merrill.
Journal of Food Protection JFPRDR, Vol. 49, No. 11, p 891-892, November 1986. 1 tab, 8 ref.

Descriptors: *Giardia, *Sample preparation, *Water analysis, *Wastewater analysis, *Centrifugation, *Membrane filters, *Public health, *Pollutant identification, Filters, Filtration, Diseases, Human diseases, Sampling, Protozoa, Parasites, Microbiological studies.

A study was undertaken to determine whether a centrifugal cream separator could remove Giardia cysts from water and could simplify and improve sampling and analysis techniques for detecting Giardia. Recovery of cysts varied from 30 to 61%, or 0.82 to 1.8 cysts recovered of 2.9 cysts/ml inoculated into the water sample. Data suggest that centrifugal cream separators are useful in concentrating Giardia cysts in water samples. Centrifugal clarifiers, designed to remove sediment from milk, also merit consideration. Recovery of cysts seemed to be inversely related to the amount of ferric iron in the water; further study is needed to remove this interference. (Doria-PTT)
W87-09209

DETERMINATION OF TOXIC ORGANOPHOSPHORUS COMPOUNDS BY SPECIFIC AND NONSPECIFIC DETECTORS,
Army Medical Research Inst. of Chemical Defense, Aberdeen Proving Ground, MD.
M. L. Shih, and R. I. Ellin.
Analytical Letters ANALBP, Vol. 19, No. 23/24, p 2197-2205, December 1986. 6 tab, 7 ref.

Descriptors: *Analytical methods, *Measuring instruments, *Toxic wastes, *Toxicity, Pesticides, Organophosphorus pesticides, Chemical analysis, Gas chromatography, Flame photometry, Soil analysis, Water analysis.

Tabun, sarin, soman, and VX represent prototypes of highly toxic organophosphorus compounds. Sample preparation procedures and gas chromatography methodology are presented for their determination in aqueous solutions. Extraction recoveries from chloroform were quantitative. Peak area ratios of organophosphorus compounds (OPs) to internal standard versus concentrations of OP were linear over the range of 10-1000 micrograms/ml when determined by the flame ionization detector and 10-800 ng/ml when determined by the flame photometric detector. Imprecision occurring at low ng concentrations of VX was caused by its adsorption on the analytical column. Acceptable precision was regained by the addition of a weak base, such as atropine, to the sample extract prior to its injection onto the gas chromatograph (GC). (Author's abstract)
W87-09220

FRESHLY PREPARED RAT HEPATOCYTES USED IN SCREENING THE TOXICITY OF BLUE-GREEN ALGAL BLOOMS,
Norwegian College of Veterinary Medicine, Oslo. Dept. of Food Hygiene.
K. Berg, and T. Aune.
Journal of Toxicology and Environmental Health JTEHD6, Vol. 20, No. 1/2, p 187-197, 1987. 4 fig, 2 tab, 10 ref.

Descriptors: *Water pollution effects, *Toxicity, *Bioindicators, *Bioassay, *Algae, *Cyanophyta, *Algal toxins, Eutrophication, Toxins, Enzymes.

The acute toxicity of extracts of blue-green algae was tested in freshly prepared rat hepatocytes in suspension. The results were compared with the traditional in vivo mouse bioassay. Sixty samples of natural algal blooms from freshwater lakes in Norway, Sweden, and Finland and 14 samples cultured in the laboratory were tested. The mouse bioassay revealed hepatotoxins in a large number of the algae, while neurotoxins were not found. Acute hepatotoxicity in vitro was scored by measurement of leakage of the enzyme lactate dehydrogenase (LDH) from damaged cells and of morphological changes of the cells. The correlation coefficients between mouse toxicity and LDH, mouse toxicity and morphological cell damage, and between LDH and morphological cell damage were 0.812, 0.735, and 0.882, respectively. Consequently, the rat hepatocyte toxicity test seems to be well suited for screening blooms of blue-green algae for the presence of hepatotoxins. (Authors' abstract)
W87-09230

NEW METHOD FOR DETERMINING THE CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS IN SEDIMENT INTERSTITIAL WATER,
Environmental Sciences Div. Lawrence Livermore National Lab., Livermore, CA 94550.
J. P. Knezovich, and F. L. Harrison.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 6, p 937-940, June 1987. 1 fig, 1 tab, 3 ref. DOE Contracts EPA-79-D-X0856 and W-7405-Eng-48.

Descriptors: *Analytical methods, *Bioaccumulation, *Sorption, *Volatile organic compounds, *Sediments, *Interstitial water, Population exposure, Toxicity, Extraction, Tritium, Chlorobenzene.

The bioaccumulation of sediment-sorbed organic contaminants is likely to be mediated by the transfer of chemicals through interstitial water. Unfortunately, laboratory studies of sediment-sorbed chemical bioavailability have either not assessed chemical concentrations in interstitial water or have utilized methods that require disruption of the sediment layers. A simple method is presented for the removal of interstitial water samples with an in situ technique. This method can be used to determine relevant exposure concentrations in laboratory studies of sediment-sorbed chemical bioavailability and toxicity. The results of the comparative interstitial water analyses indicate that the in situ extraction method greatly reduced the loss of the volatile test compound when compared to conventional methods. Quantitative recoveries of tritium and chlorobenzene (CB) were achieved with the in situ method, whereas significant losses of CB were observed with the centrifugation and squeezing methods. Control experiments conducted with tritiated surface water confirmed that only interstitial water was withdrawn by the in situ method, as no surface water was drawn into samples less than 350 microliter. Such overlying-water-sampling experiments must be conducted for individual sediments due to differences in compaction and porosity. The interstitial-water-sampling method described can be used to determine the interstitial assays. Although radiochemical detection was used in these experiments, modifications in this basic technique should permit sample quantitation by conventional analytical methods. (Alexander-PTT)
W87-09233

ATTEMPT TO MEASURE THE FLOW OF CHLORINATED HYDROCARBONS, SUCH AS PCBS, FROM WATER TO AIR IN THE FIELD,
Inst. of Limnology, Univ. of Lund, Box 65, S-22100 Lund, Sweden.
For primary bibliographic entry see Field 7B.
W87-09246

QUANTIFICATION OF PCB BY DECHLORINATION TO BIPHENYL,
Federal Office of Public Health, CH-3001 Bern, Switzerland.
A. Kuchen, O. Blaser, and B. Marek.
Fresnius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 326, No. 8, p 747-750, April 1987. 1 tab, 17 ref.

Descriptors: *Polychlorinated biphenyls, *Analytical methods, *Sample preparation, *Chemical reactions, Dechlorination, Chromatography.

Since polychlorinated biphenyls (PCB) are widespread biologically active contaminants in the environment, the need of a sensitive, rapid and simple screening-method for control purposes is obvious. The dechlorination of PCB to biphenyl with $LiAlH_4$ and subsequent quantification by HPLC and UV detection may fulfil these requirements. Results achieved with this dechlorination method are compared with those obtained by packed-column or capillary-column gas chromatography and EC detection. (Author's abstract)
W87-09259

GAS-CHROMATOGRAPHIC DETERMINATION OF TOTAL POLYCHLORINATED AROMATES AND CHLORO-PARAFFINS FOLLOWING CATALYTIC REDUCTION IN THE INJECTION PORT,
Hoechst AG, Postfach 800320, D-6230 Frankfurt 80, Federal Republic of Germany.
N. Sistovaris, and U. Donges.
Fresnius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 326, No. 8, p 751-753, April 1987. 4 fig, 1 tab, 6 ref.

Descriptors: *Organochlorine compounds, *Analytical methods, *Sample preparation, *Chemical reactions, Dehalogenation, Chromatography.

The extract of an unknown sample may contain a mixture of different patterns of chloro-aromates or chloro-paraffins, from which every pattern itself consists of various isomers with a different number of chlorines at different substitution sites. A gas chromatograph Carlo Erba 4200 was used. The insert was filled with a 2 cm layer of the catalyst mixture, 1.0% palladium chloride and approx. 12 mg/g sodium hydroxide on Chromosorb P. Following clean-up, 1 microliter of the sample dis-

solved in hexane was used for GC. A capillary column DB 5, 15 m, 0.45 micron, was used. Hydrogen served as reactor and as carrier gas. In the case of chloro-aromates, the initial temperature was 100 C, after 1 min it was rained to 260 C at a + 10 C/min rate. For chloro-paraffins, the initial temperature of 60 C was raised after 1 min to 220 C at a + 5 C/min rate. An FID was used for quantitative determination. The following substances were examined: polychlorinated biphenyls (PCBs) and terphenyls (PCTs), polychlorinated benzyltoluenes, chloro-paraffins (C10 to C17), DDT and, further, some polybrominated compounds. For the chlorinated compounds, limits of determination were in the range of 5 microgram/ml hexane solution. The brominated compounds were not quantitatively reduced. It may be expected that further modification of the method should also lead to complete debromination. (Alexander-PTT)
W87-09260

ON-LINE SULPHATE MONITORING BY REVERSED FLOW INJECTION ANALYSIS AND ALTERNATING REAGENT INJECTION,
Dept. of Chemistry, Univ. of Pretoria, Pretoria 0002, South Africa.
J. F. van Staden.
Fresnius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 326, No. 8, p 754-756, April 1987. 2 fig, 1 tab, 9 ref.

Descriptors: *Automation, *Analytical methods, *Sample preparation, *Chemical reactions, *Sulfates, Chromatography, Effluents, Reagents.

An on-line automated system for the determination of sulfate in effluent water streams based on the concept of reversed flow injection analysis and alternating reagent injection is described (turbidimetric determination of barium sulfate). The rate of determination is 60 actual analyses/h. The method is suitable for the on-site monitoring of sulfate in the concentration range up to 200 mg/l with a coefficient of variation of better than 2.0%. (Author's abstract)
W87-09261

ANALYTICAL CHEMISTRY,
Northeastern Univ., Boston, MA. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W87-09295

EFFLUENT EVALUATION,
EG and G Environmental Group, Wellesley, MA.
K. J. Macek.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 636-649, 2 tab, 14 ref.

Descriptors: *Toxicity, *Water quality control, *Effluents, *Path of pollutants, *Aquatic toxicology, *Monitoring, Legislation, Toxicity, Water sampling, Lethal limits, Wastewater treatment, Aquatic environment, Regulations.

Although the Federal Water Pollution Control Act as amended in 1972 emphasized the need to prohobit the discharge of toxic poliutants in toxic amounts, implementation of that legislation by EPA has disregarded the need to measure in meaningful terms (i.e., toxicity) the nation's progress toward that goal. Nearly a decade after the legislation was passed, neither EPA nor industry has any comprehensive quantitative measurement of whether that goal has been attained, or how much more treatment is required to attain it. In retrospect, with the emphasis on technology-based limitations it is understandable that toxicity testing of wastewater discharges with aquatic organisms has not become a barometer of progress in pollution control However, it is clear that the time has come to evaluate and quantitate progress in controlling the toxicity of industrial wastewater discharges, and this can only be accomplished by measuring their toxicity to aquatic organisms. Toxicity testing of wastewater discharges of aquatic organsisms can be used to: (1) Identify the acceptable limit (target level) for toxicity control be establishing maximum safe concentrations in the receiving water; (2) Demonstrate that current treatment technology is adequate to control toxicity to within acceptable limits or to quantify the degree of additional treatment, if any, required to control effluent toxicity to within acceptable limits; and (3) Establish the validity of surrogate parameters for monitoring effluent toxicity on a continuing basis. Unless there emerges a clear and significant role for toxicity test with aquatic organisms in this nation's effort to control effluent toxicity, regulatory progress will continue down the path of treatment for treatment's sake. Without a valid mechanism for determining when the stated goal of the act has been reached for, fishable, swimmable waters, regulatory efforts will continue to pursue the regulatory grail of fishable, swimmable pipes. (See also W87-09280) (Lantz-PTT)
W87-09302

INSTRUMENTATION FOR ENVIRONMENTAL MONITORING, VOLUME 2: WATER,
California Univ., Berkeley. Lawrence Berkeley Lab.
M. S. Quinby-Hunt, R. D. McLaughlin, and A. T. Quintanilha.
John Wiley and Sons, New York, NY. 1986. 982 p. Edited by A. E. Greenberg and G. A. Morton.

Descriptors: *Monitoring, *Water quality control, *Measuring instruments, *Pollutant identification, Inorganic compounds, Organic compounds, Biological pollutants, Physical properties, Legislation, Regulations, Standards.

Water is one the most valuable natural resources. The earth has been endowed with an ideal purification system, the evaporation-precipitation cycle. However, due to population pressures, economic tradeoffs, and human carelessness, water often reaches the ultimate user in a form far less pure than raindrops or melted snow once were. To ensure that the quality of water is maintained, numerous water quality programs have been developed, legislation has been passed, and criteria, standards, rules, and regulations have been promulgated. Numerous methods for measuring water quality constituents have been developed; these methods often require the use of sophisticated instruments to make each measurement. The purpose of this survey is to describe various water quality constituents and the instruments used to measure them. Each chapter focuses on a particular water quality constituent or group of constituents, and the instruments used to measure them. Part I describes inorganic constituents, Part II organic constituents, Part III biological constituents, and Part IV physical characteristics. Its sources and effects, and methods of control are given. The analytical methods used to measure each constituent are introduced. The theoretical principles behind the instruments used to make each measurement are described along with the instrument inself. Sometimes the same instrument may be used to measure a number of constituents; for example, ultraviolet-visible spectrophotometers are used to measure the nutrients, trace metals, some of the biomass indicators, color, and so on. In this case, the instrumental technique is described only once, and other chapters describe the adaptations necessary to measure the particular constituent. The commerical instruments available for making each measurement are described in the appendices. (Lantz-PTT)
W87-09303

ROLE OF ELECTROFISHING IN ASSESSING ENVIRONMENTAL QUALITY OF THE WABASH RIVER,
DePauw Univ., Greencastle, IN. Dept. of Zoology.
J. R. Gammon, A. Spacie, J. L. Hamelink, and R. L. Kaesler.
IN: Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms, A Symposium Sponsored by ASTM Committee D-19, Ft. Lauderdale, FL, 29-30 January 1979. ASTM STP 730, 1981. p 307-324, 7 fig, 5 tab, 12 ref.

Descriptors: *Bioindicators, *Electrofishing, *Water quality, *Wabash River, Environmental quality, Thermal pollution, Industrial wastes, Municipal wastes, Species diversity, Population, Aquatic environment.

The fish community of the middle Wabash River has been studied since 1973 from the standpoint of its capacity for measuring the biological impact of various kinds of point influences, such as thermal, municipal, and industrial effluents. Of particular interest has been the potential value of various community parameters as indicators of environmental quality, since individual species populations tend to vary markedly from year to year. The primary sampling method consisted of repeated direct-current electrofishing through a series of 0.5-km long zones located strategically throughout 274 km (170 miles) of river, divided into twelve reaches. The use of cluster analysis and community indexes, including a composite index, has been of value in isolating problem areas prior to the development of lethal environmental conditions and in gaging the degree of environmental benefit resulting from improved waste treatment. (See also W87-09311) (Author's abstract)
W87-09328

SIMULTANEOUS DETERMINATION OF LINEAR ALKYLBENZENESULFONATES, ALKYLPHENOL POLYETHOXYLATES, AND NONYLPHENOL BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
A. Macromini, and W. Giger.
Analytical Chemistry ANCHAM, Vol. 59, No. 13, p 1709-1715, July 1, 1987. 5 fig, 4 tab, 36 ref.

Descriptors: *Pollutant identification, *Chemical analysis, *Hydrocarbons, *Sludge, *Sediments, *Chromatography, Phenols, Quantitative analysis, Fluvial sediments.

Linear 4-alkylbenzenesulfonates (LAS), 4-alkylphenol polyethoxylates (APEO) (i.e. 4-octylphenol polyethoxylates) and 4-nonylphenol polyethoxylates (NPEO), and 4-nonylphenol (NP) may be determined simultaneously by liquid chromatography (HPLC) using octylsilica columns and water/acetonitrile gradient elution. The LAS are separated according to their alkyl chain lengths; coelution of NPEO and NP was observed. The determination of oligomer distributions of APEO and the quantitation of NP, 2-(4-nonylphenoxy)ethanol, and 2-(2-(4-nonylphenyloxyethylene)oxy)ethanol require information on their percentages and molar absorptivities, which may be obtained from normal-phase HPLC. Recoveries of 85%-100% were found for LAS, APEO, and NP isolated from sewage sludge, sludge-amended soils, and river sediments. Relative standard deviations for all analytes in the different matrices did not exceed 6%. Detection limits with UV fluorescence detection are 95 ng for NP, 80 ng for LAS, and 65 ng for NPEO with respect to injected amounts. (Peters-PTT)
W87-09343

COMPARISON OF THE HYDROPHOBIC-GRID MEMBRANE FILTER PROCEDURE AND STANDARD METHODS FOR COLIFORM ANALYSIS OF WATER,
Environmental Monitoring and Support Lab.-Cincinnati, OH. Biological Methods Branch.
A. E. McDaniels, R. H. Bordner, J. R. Menkedick, and C. I. Weber.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 5, p 1003-1009, May 1987. 5 fig, 5 tab, 16 ref.

Descriptors: *Analytical methods, *Water analysis, *Comparison studies, *Hydrophobic-grid membrane filter, Coliforms, Bacteria, Chlorination, Estimating.

The hydrophobic-grid membrane filter (HGMF) has been proposed as an alternate method to the standard membrane filter (MF) procedure for the detection and enumeration of coliforms from water. Eight samples of nonchlorinated wastewater effluents were analyzed by the

HGMF, standard MF, and tube fermentation most-probable-number methods for fecal coliforms, and eight samples each of polluted surface and dosed drinking waters were analyzed by the same methods for total coliforms. The drinking waters were dosed with coliforms and other heterotrophs concentrated from nonchlorinated domestic wastewater and treated with chlorine to reduce the numbers of organisms and simulate stress caused by chlorination. Statistical analyses determined that recoveries of fecal coliforms were significantly higher by the filtration methods for the nonchlorinated domestic wastewaters but not for the other waters. The results also indicated that recoveries of fecal and total coliforms did not differ significantly when either MFs or HGMFs were used. Total coliform results obtained with HGMFs having > 100 positive grid cells were significantly more precise than estimates obtained by the standard MF method only for polluted surface waters. (Author's abstract)
W87-09392

A-ELISA TO DETECT HEPATITIS A VIRUS IN ESTUARINE SAMPLES,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
A. M. Nasser, and T. G. Metcalf.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 5, p 1192-1195, May 1987. 1 fig, 1 tab, 23 ref. NOAA Grant NA83AA-H-0075.

Descriptors: *Analytical methods, *Amplified-ELISA, *ELISA, *Hepatitus A, *Viruses, *Estuaries, Sample preparation, Sensitivity, Radioimmunoassay, Humic material.

An amplified enzyme-linked immunosorbent assay (A-ELISA) for detecting and quantifying hepatitis A virus in estuarine water samples is described. The test was five times more sensitive than a standard ELISA and at least two times more sensitive than radioimmunoassay. Test sensitivity was unaffected by the procedures used to concentrate the virus in estuarine samples or by the presence of humic and tannic acids in test samples. Nonspecific reactions were not encountered with a number of enteroviruses or with a rotavirus. A high sensitivity and specificity combined with speed, low cost, and freedom from radiolabels made the A-ELISA useful for detecting hepatitis A virus in environmental samples. The virus was detected in 3 of 20 estuarine water samples examined by A-ELISA. (Author's abstract)
W87-09396

EVALUATION OF THE MULTITEST MEDIUM FOR RAPID PRESUMPTIVE IDENTIFICATION OF VIBRIO CHOLERAE FROM ENVIRONMENTAL SOURCES,
National Inst. of Cholera and Enteric Diseases, Calcutta 700 010, India.
G. B. Nair, S. Misra, R. K. Bhadra, and S. C. Pal.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 5, p 1203-1205, May 1987. 2 tab, 6 ref.

Descriptors: *VC medium, *Analytical methods, *Vibrio, *Culturing media, Isolation, Performance evaluation, Cultures, Microbiology, India.

The multitest V. cholerae medium (VC medium) for rapid presumptive identification of Vibrio cholerae was evaluated. On the basis of reactions in the VC medium, 379 strains recovered during a yearlong ecological study in Calcutta were presumptively identified as V. cholerae. Further phenotypic characterization of these strains revealed that the reactions of 371 (97.9%) isolates were consistent with that of V. cholerae. False-positive reactions were exhibited by eight (2.1%) strains, three of which were identified as Vibrio fluvialis biotype 1. By slightly varying the basic formulation of the VC medium, we could eliminate some false-positive reactions. On the basis of the present evaluation, we recommend the routine use of the VC medium. (Author's abstract)
W87-09397

ANTIBIOTIC-RESISTANT PSEUDOMONAS IN BOTTLED DRINKING WATER,
Dept. of Biology, Northeastern Univ., 360 Huntington Avenue, Boston, MA, U.S.A. 02115.
For primary bibliographic entry see Field 5F.
W87-09424

GUIDELINES FOR SAMPLING AND ANALYZING SOLUTIONS FROM AQUIFER THERMAL-ENERGY-STORAGE SYSTEMS,
Battelle Pacific Northwest Labs., Richland, WA.
W. J. Deutsch.
Available from the National Technical Information Service, Springfield, VA 22161, as DE83-001852, A10 in paper copy, A01 in microfiche. PNL-4355, September 1982. 11 p, 1 fig, 3 tab, 18 ref. Contract No. DE-AC06-76RLO 1830.

Descriptors: *Pollutant identification, *Water analysis, *Sampling, Wells, Flushing, Thermal water, Water storage, Storage, Sample preparation, Water sampling.

Guidelines for sampling and analyzing water from simulated or real groundwater energy storage systems are given. They include methods for flushing wells of stagnant water and monitoring selective solutionparameters (pH, Eh, temperature or conductivity) as indicators of flushing efficiency. The more unstable groundwater parameters (temperature, pH, Eh, dissolved oxygen, and conductivity) should be measured onsite. Alkalinity, sulfide, and ammonia should be determined within 24 hours of sampling. Samples of groundwater should be tested for major cations, anions, trace metals, organic and inorganic carbon and certain redox couples (Fe2+/Fe3+ and As3+/As5+) following proper filtration, preservation, and storage. As a final check, the cation-anion balance should be compared with measured conductivity. (Cassar-PTT)
W87-09457

POLYCYCLIC AROMATIC HYDROCARBONS IN OYSTERS (CRASSOSTREA VIRGINICA) FROM GEORGIA COASTAL WATERS, ANALYZED BY HIGH-PRESSURE LIQUID CHROMATOGRAPHY,
Skidaway Inst. of Oceanography, Savannah, GA.
R. F. Lee, D. Lehsau, M. Madden, and W. Marsh.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 341-345, 5 fig, 2 tab, 31 ref.

Descriptors: *Chemical analysis, *Oil pollution effects, *Oil spills, *Chromatography, *Ecological effects, *Oysters, Polycyclic aromatic hydrocarbons, Coastal waters, Georgia, Methylfluorene, Anthracene, 2,3-benzofluorene, Methylpyrene, 2,3-benzanthracene, Benzo(b)fluoranthene, Benzo(a)fluoranthene.

A number of polycyclic aromatic hydrocarbons (PAH) were detected in oysters from sites in coastal Georgia with analysis by reverse-phase liquid chromatography with fluorescence detection. Compounds were identified by collection of peaks and comparison of excitation and emission fluorescence spectra with authentic standards. Major PAH in the oysters from the ports of Savannah and Brunswick included methylfluorene, anthracene, 2,3-bezofluorene, methylpyrene, 2,3-benzanthracene, benzo(b)fluoranthene, benzo(a)pyrene, and benzo(k)fluoranthene. Concentrations of most PAH were low in oysters from Skidway River, which is part of the intercoastal waterway, and Kings Bay Submarine Base. The concentration of benzo(a)pyrene, a wellknown carcinogen, was 0.5 micrograms per kilogram in Brunswick and Savannah but was not detected (less than 0.01 micrograms per kilogram) in Skidway River and Kings Bay. (See also W87-09507) (Author's abstract)
W87-09542

5B. Sources Of Pollution

CARCINOGENIC EFFECTS IN A/J MICE OF PARTICULATE OF A COAL TAR PAINT USED IN POTABLE WATER SYSTEMS,
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5C.
W87-08613

RESEARCH NEEDS IN VALIDATING AND DETERMINING THE PREDICTABILITY OF LABORATORY DATA TO THE FIELD,
Colorado State Univ., Fort Collins. Water Resources Lab.
For primary bibliographic entry see Field 5C.
W87-08631

MULTISPECIES TESTS: RESEARCH NEEDS TO ASSESS THE EFFECTS OF CHEMICALS ON AQUATIC LIFE,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 5A.
W87-08632

AQUATIC HAZARD ASSESSMENT: PICLORAM,
Dow Chemical Co., Midland, MI. Dept. of Health and Environmental Sciences.
For primary bibliographic entry see Field 5C.
W87-08643

INTERLABORATORY COMPARISON OF THE ASTM BIOCONCENTRATION TEST METHOD USING THE EASTERN OYSTER,
Environmental Protection Agency, Narragansett, RI.
For primary bibliographic entry see Field 5A.
W87-08645

USEFULNESS OF THE LIPID INDEX FOR BIOACCUMULATION STUDIES WITH DAPHNIA MAGNA,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5C.
W87-08652

PHYSICAL/CHEMICAL PROPERTIES OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN,
Monsanto Co., St. Louis, MO.
J. M. Schroy, F. D. Hileman, and S. C. Cheng.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 409-421, 2 fig, 7 tab, 19 ref.

Descriptors: *Dioxins, *Physical properties, *Chemical properties, *Path of pollutants, Model studies, Soil column, Fate of pollutants, Evaporation.

Limited and inaccurate physical property data for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) have inhibited the development of good environmental transport and fate information for this material. Based on limited literature data and transport modelling techniques evaporation of 2,3,7,8-TCDD from the soil column was proposed as a major factor in its movement in the environment. Estimated physical properties data were used to focus field sampling and analytical work and to identify the key physical property parameters that required quantification. Initial predictions indicating soil column loss via evaporation have been confirmed, losses via evaporation have been confirmed, and a set of physical properties suitable for environmental transport modeling have been compiled. (See also W87-08624) (Author's abstract)
W87-08657

ENVIRONMENTAL MOBILITY OF DIOXINS,
Monsanto Co., St. Louis, MO.
R. A. Freeman, and J. M. Schroy.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 422-439, 6 fig, 7 tab, 50 ref.

Descriptors: *Path of pollutants, *Dioxins, *Model studies, *Times Beach, *Missouri, Soil column, Organic compounds, Mathematical models.

A model has been developed to describe the vapor phase transport of low volatility organic chemicals in a soil column. The mathematical model finds the rate of vapor transport by solving the dynamic material and energy balance around a soil column. The model is used to make predictions on the transport of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) at the Times Beach, MO site. Based on this analysis, the following conclusions about the transport of TCDD can be reached: (1) TCDD is volatile; (2) Vaporization is one mechanism that can be used to describe the TCDD concentration profiles measured in the soil of Times Beach, MO. The transport of TCDD into and from a soil column can be described by a temperature driven process; (3) Based on a simulation of the measured concentration profile of TCDD at the end of ten years and an estimate of the initial surface concentration, it may be concluded that: (a) TCDD will volatilize from soils most rapidly during the summer months. TCDD will not volatilize from soils to any appreciable extent during the winter. (b) Over 50% of the total applied TCDD volatilized during the first summer after initial application at Times Beach. (c) Over 90% of the applied TCDD volatilized from the top 1 cm of soil during the first summer. (See also W87-08624) (Author's abstract)
W87-08658

BIOCONCENTRATION OF FOUR CHLORINATED DIOXINS BY RAINBOW TROUT AND FATHEAD MINNOWS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. C. G. Muir, A. L. Yarechewski, and G. R. B. Webster.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 440-454, 3 fig, 4 tab, 25 ref.

Descriptors: *Biological magnification, *Chlorinated dioxins, *Trout, *Minnows, *Path of pollutants, Carbon radioisotopes, Accumulation, Absorption, Tissue analysis.

Accumulation of four 14-C-labelled chlorinated dibenzo-p-dioxins (1,2,3,7-tetrachloro- (T sub 4 CDD), 1,2,3,4,7-pentachloro- (P sub 5 CDD), 1,2,3,4,7,8-hexachloro- (H sub 6 CDD), and 1,2,3,4,6,7,8,-heptachloro -(H sub 7 CDD) isomers) from water by rainbow trout fry (Salmo gairdneri) and fathead minnows (Pimephales promelas) was studied using a 5-day exposure period followed by a 24-day elimination phase. Water concentrations of these hydrophobic compounds (measured after centrifugation) ranged from 0.005 to 0.10 ng/mL during the fish exposures. Equilibrium bioconcentration factors calculated by use in a rainbow trout and from 515 for H sub 7 CDD to 4232 for H sub 6 CDD in fathead minnows. Elimination rates of T sub 4 CDD and P sub 5 CDD isomers were similar and rapid, with half-lives of total radioactivity averaging about 2.6 days in trout fry and 3.0 days in minnows. Half-lives of isomers averaging about 16 days in rainbows and 20 days in fatheads. Low bioconcentration by both species was attributed to the high proportion of total radioactivity in water apparently unavailable to the fish because of association with suspended and dissolved material and to poor membrane transport. (See also W87-08624) (Author's abstract)
W87-08659

MODEL FOR ESTIMATING THE LOADING RATE OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN TO THE GREAT LAKES,
Dow Chemical Co., Midland, MI. Agricultural Research Lab.
W. B. Neely.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 455-467, 2 fig, 5 tab, 24 ref.

Descriptors: *Limnology, *Model studies, *Pollutant load, *Dioxins, *Great Lakes, *Path of pollutants, *Lake Huron, Aquatic environment, Organic compounds, Monitoring, Lakes.

Identifying trace contaminants in environmental samples is becoming a common occurrence. In order to complement this activity a method is needed to estimate the loading rate that is required to achieve the observed concentrations. By matching the loading rate with identified sources an assessment of their importance can be made. This study presents a framework by which loading rates can be estimated for the Great Lakes watershed. Using data and monitoring results for 2,3,7,8-tetrachlorodibenzo-p-dioxing (TCDD) the model is illustrated, and a loading rate of 600 g/yr was determined necessary to achieve the TCDD concentrations observed in Lake Huron fish. (See also W87-08624) (Author's abstract)
W87-08660

ENVIRONMENTAL EXPOSURE FROM CHEMICALS.
Volume II, CRC Press, Inc., Boca Raton, FL. 1985. 150 p. Edited by W. Brock Neely and Gary E. Blau.

Descriptors: *Path of pollutants, *Mathematical models, *Model studies, *Water pollution effects, Lakes, Rivers, Estuaries, Hazard assessment, Environmental effects, Ecosystems.

The basic principles of mathematical modeling are introduced, types of models are discussed ranging from simple empirical models to complex phenomenological ones. Methods for building models from controlled laboratory ecosystems discussed together with the difficult and costly problem of scale-up and validation of such models in the field. Although specific examples are used for illustrative purposes, real world applications are dealt with: (1) transport in the atmosphere; (2) transport in lakes, rivers and estuaries; (3) and transport from land, and (4) how the resultant concentration time profiles can be used to assess the hazard to man and translate this hazard into a risk-benefit analysis. (See also W87-08671 through W87-08673) (Lantz-PTT)
W87-08670

ENVIRONMENTAL SYSTEMS ANALYSIS: AN OVERVIEW,
Dow Chemical Co., Midland, MI. Agricultural Products Dept.
G. E. Blau.
In: Environmental Exposure from Chemicals, Volume II, CRC Press, Inc., Boca Raton, FL. 1985. p 1-20, 4 fig, 24 ref.

Descriptors: *Water pollution effects, *Environmental effects, *Path of pollutants, *Mathematical models, *Model studies, *Mathematical studies, Equilibrium, Ecosystems.

To assess the hazard or potential hazard of a chemical to man and his environment, it is essential to understand the behavior of the chemical once it is introduced into the environment. Behavior is defined as the concentration time profile of a chemical in various parts or segments of the environment. To generate a profile, requires a study of the transport phenomena within and between these segments. The problem is analogous to thermodynamic and kinetic considerations for studying a chemical reaction. In the considerations of assessing risk, the time varying or 'transient' concentration of a chemical in the different parts of the environment is critical. For example, the ability to predict the concentration time profile in a river following an accidental chemical spill or in the atmosphere following a chemical release are essential to developing meaningful emergency procedures. For new products, the ability to predict the concentration time profile under many different scenarios prior to its introduction into the marketplace can be used both by industry and government policymakers to assess the liabilities of the product at an early stage of its development. This paper is devoted to introducing the basic concepts of mathematical modelling and the more general concepts of systems analysis. Although simple examples are included to illustrate the concepts, emphasis is placed on the tools themselves. (See also W87-08670) (Lantz-PTT)
W87-08671

MODELING CHEMICAL TRANSPORT IN LAKES, RIVERS, AND ESTUARINE SYSTEMS,
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
J. L. Schnoor.
In: Environmental Exposure from Chemicals, Volume II, CRC Press, Inc., Boca Raton, FL. 1985. p 55-73, 6 fig, 2 tab, 27 ref.

Descriptors: *Limnology, *Path of pollutants, *Lakes, *Estuaries, *Rivers, *Model studies, *Mathematical models, *Fate of pollutants, Aquatic environment, Chemical reactions, Mathematical studies.

The fate of toxic chemicals in the aquatic environment is determined by two factors: their reactivity, and the rate of their physical transport through the environment. All mathematical models of the fate of toxic chemicals are simply useful accounting procedures for the calculation of these processes as they become quite detailed. To the extent that the biological, chemical, and physical reactions and transport of toxic substances can be accurately predicted, their fate and persistence and the inevitable exposure to aquatic organisms can be modeled. Several models exist to estimate the fate and transport of toxic chemicals in lakes, rivers, and estuaries. Because of the inherent complexities of transport, estuarine modeling has not advanced as far as the others. In this chapter, transport of chemicals in the aquatic environment was described, and simplifications of the mass balance equations were developed. In some cases considerable insight can be gleaned from a simplified approach. The required level of model complexity depends on the user's needs, expertise, and data base. Two examples of some 'first-cut' approximations to chemical fate and transport illustrated the utility of this approach. (See also W87-08670) (Lantz-PTT)
W87-08672

NONPOINT SOURCE POLLUTION MODELS FOR CHEMICALS,
Anderson-Nichols, Inc., Palo Alto, CA.
A. S. Donigian, and J. D. Dean.
In: Environmental Exposure from Chemicals, Volume II, CRC Press, Inc., Boca Raton, FL. 1985. p 75-105, 5 fig, 4 tab, 74 ref.

Descriptors: *Water pollution sources, *Model studies, *Nonpoint pollution sources, Mathematical models, Ecosystems, Path of pollutants, Mathematical studies.

Public and legislative concern for the magnitude and effects of nonpoint source pollution (NPS) evolved during the decade of the 1970s. During that period, the primary recognized water quality problems were dissolved oxygen deficits, eutrophication, and bacterial pollution associated primarily with urban, agricultural, and other land use activities. The contemporary water quality indicators were DO, BOD, nutrients, and coliforms; pesticide pollution was becoming recognized as a growing water quality concern limited to specific environments and regions of the country with concentrated agricultural and silvicultural activities. Since the late 1970s, the characterization of the NPS pollution problem has taken on a new and alarming change with emphasis on exotic toxic chemicals and hazardous wastes. The growing EPA list of uncontrolled hazardous waste sites, the common occurrence of chemical spills, and the wide-spread detection of PCBs, dioxin, and pesticides have all helped to redefine the nonpoint source problem of the 1970s as chemical nonpoint source pollution in the 1980s. Models are used to analyze system behavior under both current (or past) conditions and proposed future conditions. Although modeling requires some basic knowledge of the system being analyzed, it also promotes an improved understanding of the system through sensitivity analyses of system characteristics and observation of the resulting system response, as predicted by the model. The most critical and cost-effective use of models is in the analysis of proposed or alternative future conditions. Models, as used in this paper, are simply representations of environmental systems. They are not exact, but rather simplifications of a real system since no model can realistically repre-

sent in detail the intricate workings of real environmental systems. Most mathematical models of environmental systems can be referred to as 'linked-process models' since they include mathematical representations of individual processes and their interactions (or linkage) in order to approximate an entire environmental system. (See also W87-08670) (Lantz-PTT)
W87-08673

ENVIRONMENTAL EXPOSURE FROM CHEMICALS.
Volume I, CRC Press, Inc., Boca Raton, FL. 1985. 245 p. Edited by W. Brock Neely and Gary E. Blau.

Descriptors: *Fate of pollutants, *Water pollution effects, *Risk assessment, *Path of pollutants, *Model studies, *Physical properties, *Chemical properties, Chemical reactions, Degradation, Mathematical studies, Hydrolysis.

This two volume series describes the mechanisms that operate on chemicals as they move in the environment. Knowledge of these mechanisms is a vital component in performing a risk assessment. Volume 1 deals with the physical and chemical properties of a material and how these influence the degradation and dissipating reactions as well as techniques by which physical properties and sorption phenomena may be estimated. Volume 2 addresses the transport of the chemical as it moves through the environment from the source to the final sink. Degradation mechanisms due to microorganisms, hydrolysis, and photodegradation are summarized. All of these reactions are integrated into a simple equilibrium model. Such a model provides a quick determination of the environmental exposure that might be expected from the chemical under investigation. (See W87-08676 thru W87-08683) (Lantz-PTT)
W87-08675

ESTIMATION OF PHYSICAL PROPERTIES,
Little (Arthur D.), Inc., Cambridge, MA.
W. J. Lyman.
IN: Environmental Exposure from Chemicals, Volume I, CRC Press, Inc., Boca Raton, FL. 1985. p 13-47, 3 fig, 12 tab, 88 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, Mathematical studies, Mathematical equations, Model studies, Henry's Law, Vapor pressure, Physical properties, Estimation, Water solubility.

The first law of environmental pollution states that everything has to go somewhere. Two questions follow directly for any specific chemical pollutant: (1) Where does it go; and (2) How fast does it get there. This leads to consideration of what chemical properties are needed to assess environmental transport and fate. About 40 properties are of interest, such as physical state, viscosity, Henry's Law constant, bioconcentration factors, and acid dissociation constant. Other properties are of interest primarily because of they may be used as an input in some equation to estimate a more pertinent property. A good example of this is the octanol-water partition coefficient; this property is widely used as an indicator of a chemical's tendency to partition from water into organic matter and is, used to estimate such properties as water solubility, soil adsorption coefficients, and bioconcentration factors for aquatic life. Similarly, the activity coefficient may be used to estimate water solubility and Henry's law constant. Measured values are not readily available for a majority of the desired chemical properties. Furthermore, the quality of the measured values that are available is variable. The answer to the problem is chemical property estimation. By this is meant the quantitative calculation of a property value from an equation or set of rules that may require other properties as input, or may only require a knowledge of the chemical's structure. Much work has been undertaken in the last decade to develop and improve the needed methods; much more remains to be done. Several aspects of property estimation for environmentally important properties are reviewed. They include specific estimation methods for vapor pressure, water solubility, and Henry's law constant. (See also W87-08675) (Lantz-PTT)
W87-08676

POLLUTANT SORPTION IN ENVIRONMENTAL SYSTEMS,
Environmental Research Lab., Athens, GA.
S. W. Karickhoff.
IN: Environmental Exposure from Chemicals, Volume I, CRC Press, Inc., Boca Raton, FL. 1985. p 49-64, 1 fig, 1 tab, 70 ref.

Descriptors: *Fate of pollutants, *Ecosystems, *Sorption, *Mathematical studies, *Model studies, Path of pollutants, Chemical reactions, Temporal distribution, Spatial distribution.

Pollutant fate in an environmental system is highly dependent on sorptive behavior. In addition to an obvious effect on physical transport, sorption can be involved directly or indirectly in pollutant degradation. The chemical reactivity of a pollutant in a sorbed state may differ significantly from that in aqueous solution, both in extent and chemical pathway. Moreover, natural sorbents may indirectly mediate solution phase processes by altering the solution phase pollutant concentration, or by controlling pollutant release into the aqueous phase and thereby potentially rate-limiting the solution phase reaction. Natural sorbents may be biotic and abiotic, may be organic, inorganic, or chemical composites thereof, and may range in size from macromolecules to gravel. Organic pollutants vary in size (single carbon to macromolecular compounds) and in water solubility, from complete miscibility to virtual insolubility. This high degree of variability and complexity in sorbent/sorbate composition, chemical character, and potential sorptive interactions seems to preclude the development of simplistic sorption models with any degree of theoretical legitimacy. The key to such model development involves discriminating essential behavior (trends) while neglecting second-order effects or incidental details. A fundamental prerequisite to model development is definition of purpose. Model structure is intimately a function of intended use. The sorption models described are designed for engineering applications and can serve the following purposes: (1) a priori estimation of pollutant sorption behavior using commonly measured (or computed) physical properties of pollutant and sorbent and incorporating commonly measured environmental variables; (2) guidance for ordering, interpreting and understanding existing data; (3) evaluation or screening of existing data based on expected behavior; and (4) extrapolation of sorption measurements (field or laboratory) outside the domain of measurement. Physical rationale is offered in support of mathematical functionality to define (or extend) appropriate models where the current state of knowledge or available data are insufficient for model definition. (See also W87-08675) (Lantz-PTT)
W87-08677

AIR/SOIL EXCHANGE COEFFICIENTS,
Louisiana State Univ., Baton Rouge. Dept. of Chemical Engineering.
L. J. Thibodeaux, and H. D. Scott.
IN: Environmental Exposure from Chemicals, Volume I, CRC Press, Inc., Boca Raton, FL. 1985. p 65-89, 2 fig, 6 tab, 50 ref.

Descriptors: *Path of pollutants, *Air-earth interfaces, *Mathematical studies, Exchange coefficients, Diffusion, Soil water, Pesticides, Oil pollution, Sulfur, Nitrogen.

The transport processes which occur near the air/soil interface play an important role in regulating chemical movement in this region. The following dominant transport process steps are known to be operative: (1) molecular diffusion in the aqueous phase of the soil water; (2) molecular diffusion in the vapor phase of the soil air; (3) convective transport due to the flow of soil water to the surface; (4) convective transport due to the flow of soil air and/or other gases to the surface; (5) movement through the interface plane; (6) molecular diffusion through the laminar air sublayer immediately above the soil surface; (7) combined molecular/turbulent transport through the buffer zone; (8) turbulent transport (mechanical) into the lower atmosphere; and (9) turbulent transport (thermal) from the soil surface into the lower atmosphere. Exchange coefficients are needed in modeling efforts aimed at predicting rates of chemical movement to and from the soil. Typical applications in which a knowledge of transport rates is important are the vaporization of pesticides from agricultural land, hydrocarbons from petroleum landfarms, chlorinated volatiles from landfill cells, and the dry deposition of oxides of sulfur and nitrogen onto soil surfaces. The purpose of this paper is to present the state of the art on estimating the exchange coefficients between soil and air, concluding with recommendations of equations and techniques by which to estimate the coefficients for the benchmark chemicals. (See also W87-08675) (Lantz-PTT)
W87-08678

AIR/WATER EXCHANGE COEFFICIENTS,
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
D. Mackay.
IN: Environmental Exposure from Chemicals, Volume I, CRC Press, Inc., Boca Raton, FL. 1985. p 91-108, 5 fig, 1 tab, 28 ref.

Descriptors: *Path of pollutants, *Air-water interfaces, *Mathematical studies, *Great Lakes, Polychlorinated biphenyls, Volatilization, Henry's Law, Kinetics, Equilibrium, Solubility, Vapor pressure.

The most difficult pollutant transport systems from the viewpoint of predicting volatilization, those in which a sparingly soluble, low vapor pressure compound is transferring between water containing sorbing material, to air which contains appreciable quantities of depositing particulate matter. For example, some controversy exists about the direction and magnitude of PCB transfer between air and water in the Great Lakes. The net exchange process may be the sum of several complementary and competing processes which are difficult to measure individually. The presence of a surface organic layer which stores hydrophobic organics and may impede their transfer is an additional complication. It is believed, that the predictive methods for calculating air-water exchange processes are well founded in physical reality and that the equations are reliable and widely applicable. When assessing the transfer characteristics of a chemical in a given environment, a rigorous and systematic series of steps is as follows: (1) Obtain accurate and mutually consistent data for solubility, vapor pressure, and Henry's law constant; (2) Obtain concentration data in both air and water including an assessment of extent of sorption coefficients or Z values; (3) Measure volatilization rates in the laboratory using distilled and natural waters including a benchmark chemical, and compare the results with theoretical predictions; (4) Estimate the prevailing environmental values of the kinetic transfer coefficients from correlations using the applicable meteorological and hydrodynamic data and taking advantage, where possible, of transfer estimates for oxygen or water; and (5) Finally, apply the equilibrium and kinetic data to the equations presented earlier either treating each process individually, or examining them collectively in a comprehensive fugacity model. (See also W87-08675) (Lantz-PTT)
W87-08679

BIODEGRADATION,
Dow Chemical Co., Midland, MI. Environmental Sciences Research.
G. M. Klecka.
IN: Environmental Exposure from Chemicals, Volume I, CRC Press, Inc., Boca Raton, FL. 1985. p 109-155, 8 fig, 7 tab, 232 ref.

Descriptors: *Biodegradation, *Fate of pollutants, *Organic compounds, Aquatic environment, Microbial degradation, Mathematical studies, Degradation, Path of pollutants, Microbiological studies.

Biodegradation is one of the major processes that determines the fate of organic chemicals in aquatic

and terrestrial environments. Microbial degradation is unique in contrast to nonbiological fate processes in that organic substrates are often completely mineralized to inorganic products. The accumulation of intermediate products is largely eliminated due to the activities of diverse microbial communities in the environment. The microbial degradation of a number of chemicals in natural waters and soils is described by first-order kinetics, and thus the rates of biological reactions can be expressed in terms of rate constants. Since first-order rate constants are often subject to considerable variability, the extrapolation of rate constants between different systems requires an understanding of the importance of microbial numbers or activities in determining the reaction rate. One approach to this problem involves normalizing rate constants by the size of the total microbial population as enumerated by a standard plate count. However, a considerable number of studies have shown that biodegradation rates do not consistently correlate with any measurement of the total microbial population. Thus, further studies are necessary to determine the relationship between reaction rates and the concentration or activity of the specific microorganisms responsible for degrading a compound. The extrapolation of laboratory derived rate constants to the environment also requires an understanding of the various biological, chemical, and physical factors and the integration of these effects into mathematical models. The significance of many of the major environmental variables is poorly understood, and few quantitative relationships are available. Several questions regarding the effects of substrate concentration, sorption, oxygen gradients, and the availability of nutrients on biological transformation rates remain to be answered. These effects will need to be evaluated if laboratory data are to be successfully extrapolated to describe the fate of chemicals in the environment. (See also W87-08675) (Lantz-PTT)
W87-08680

HYDROLYSIS,
Dow Chemical Co., Midland, MI. Dept. of Agricultural Products.
W. B. Neely.
IN: Environmental Exposure from Chemicals, Volume I, CRC Press, Inc., Boca Raton, FL. 1985. p 157-173, 2 fig, 9 tab, 36 ref.

Descriptors: *Fate of pollutants, *Hydrolysis, *Chemical reactions, Environmental effects, Degradation, Mathematical studies, Ecosystems, Path of pollutants.

The importance of hydrolysis in the environmental fate of pollutants is that the reaction introduces a hydroxyl group into the parent molecule. The resulting product is usually more susceptible to further attack through the process of biodegradation and photolysis. Furthermore, the hydroxyl group makes the chemical more water soluble and hence reduces the potential for bioconcentration. For those molecules that undergo hydrolysis, the ability to estimate the rate constant depends on how much previous work has been done in that particular family. Theoretical chemistry has not yet reached the level of sophistication where a prediction of reactivity can be made based on the structure. Consequently, reliance on the various linear free energy relations that have been developed for predicting rate constants is necessary. However, the best value is an experimentally derived number and every effort should be made to measure the rate and/or search the literature for a suitable value. Once a constant is obtained it should be examined in light of the ecosystem where it will be used. This is necessary as the value derived under laboratory conditions may have no relation to the real world. (See also W87-08675) (Lantz-PTT)
W87-08681

PHOTOCHEMICAL TRANSFORMATIONS,
SRI International, Menlo Park, CA. Physical Organic Chemistry Dept.
T. Mill, and W. Mabey.
IN: Environmental Exposure from Chemicals, Volume I, CRC Press, Inc., Boca Raton, FL. 1985. p 175-216, 5 fig, 12 tab, 100 ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Chemical reactions, *Photochemistry, Photoactivation, Photolysis, Hydrogen ion concentration, Turbidity, Temperature.

Many organic chemicals introduced into the environmental absorb sunlight and undergo transformations to new molecular species. Organic photochemistry has been an area of vigorous research for the past 30 years with general emphasis on the relation of molecular structure to photoprocesses. Experimental methods can now provide information on lifetimes, identities and reactivities of excited states and intermediates, reaction rate constants and products. Environmental chemists have now begun to examine in some detail environmental photochemical processes where sunlight is the energy source, reactant concentrations are low, and aerated water is the solvent. Two of the principal concerns of environmental chemists are to measure and/or predict the rates and products of transport or transformation process in some environmental compartment, and to understand how environmental factors such as pH, turbidity, cloud cover or temperature affect the process. For photochemical processes the chemist must devise ways of using photolysis rates measured using artificial light sources and thin optical cells to make accurate predictions of photolysis rates in sunlight in shallow or deep and clear or turbid natural waters and at different times of year. Despite the complexity of this problem, experimental measurements and theoretical predictions for environmental photolysis rate constants generally are in good agreement. (See also W87-08675) (Lantz-PTT)
W87-08682

EQUILIBRIUM MODELS FOR THE INITIAL INTEGRATION OF PHYSICAL AND CHEMICAL PROPERTIES,
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
S. Paterson.
IN: Environmental Exposure from Chemicals, Volume I, CRC Press, Inc., Boca Raton, FL. 1985. p 217-231, 1 fig, 7 tab, 21 ref.

Descriptors: *Equilibrium, *Model studies, *Physical properties, *Fate of pollutants, *Chemical properties, *Path of pollutants, Ecosystems, Mathematical models.

The main use of an environmental model is the prediction of the behavior of a chemical in the environment. This knowledge is essential in the avoidance of disruptive effects to the ecosystem by new and existing chemicals. Additional incentives for improving this capacity include the prevention of adverse health effects to humans and other organisms, increased knowledge of the pathways and persistence of a substance in the environment, and the development of appropriate regulatory aids. This capability clearly requires data on the compound's physical chemical properties and reactivity usually obtained experimentally. But it is not always immediately obvious how this information can be used to assess the partitioning and persistence of the chemical in the environment. A description is given of simple equilibrium models which help to elucidate the ultimate fate of the chemical by integrating the experimental data; determining the relative concentrations of the substance in various compartments of the environment; and assessing the degradative process which controls its behavior and persistence. A brief description is also given of transport processes which may be included in a nonequilibrium model. Most of these models are based on the use of evaluative environments which usually consist of well-defined, homogeneous compartments of specified volumes and properties. It is useful first to review briefly the need for, and nature of, these environments. (See also W87-08675) (Lantz-PTT)
W87-08683

IMPACT OF MESOSCALE CONVECTIVE SYSTEMS ON REGIONAL VISIBILITY AND OXIDANT DISTRIBUTIONS DURING PERSISTENT ELEVATED POLLUTION EPISODES,
For primary bibliographic entry see Field 2B.
W87-08695

TRACER STUDY OF VERTICAL EXCHANGE BY CUMULUS CLOUDS,
Environmental Protection Agency, Research Triangle Park, NC. Atmospheric Science Research Lab.
For primary bibliographic entry see Field 2A.
W87-08699

BACTERIOLOGICAL QUALITY OF DRINKS FROM VENDING MACHINES,
University Hospital of Wales (Cardiff). Public Health Lab.
For primary bibliographic entry see Field 5F.
W87-08704

90SR AND 137CS IN PEAT DEPOSITS OF LOW-LYING BOG IN THE INFLUENCE ZONE OF THE BELOYARSK ATOMIC POWER STATION,
M. G. Nifontova, V. I. Makovskii, and N. V. Kulikov.
Soviet Journal of Ecology SJECAH, Vol. 17, No. 3, p 153-158, January 1987. 5 tab, 8 ref. Translated from Ekologiya, No. 3, p 46-51, May-June 1986.

Descriptors: *Path of pollutants, *Strontium, *Cesium, *Peat, *Radioisotopes, Atomic power plants, Bogs, Distribution.

Radioactive disbalanced water increases the radionuclide content in bog vegetation. The concentration of radionuclides in the plants of the areas of the Ol'khovskoe bog permanently flooded with waste water from an atomic energy station is 10-100 times higher than in a control bog. 137Cs accumulation in the Ol'khovskoe bog plants is approximately ten times greater than that of 90Sr. This is because more 137Cs than 90Sr is discharged in the atomic power station disbalanced water. The data show that the discharge of disbalanced water from the Beloyarsk atomic power station over its 20 years of operation has led to a 2-9 fold increase in 90Sr content in various areas of the Ol'khovskoe bog peat bed; 137Cs content has increased 16-230 times as compared with a control bog which has not been subjected to such pollution. Areas of the Ol'khovskoe bog periodically flooded with radioactive waste have suffered less pollution than the permanently flooded parts. In all investigated areas the upper peat layers, which interact directly with the waste water, showed higher radionuclide concentrations: from 28 to 44% more 90Sr, and from 43 to 53% more 137Cs retained in the upper 0-25 cm peat layers, and 80-95% more of the combined content of both radionuclides stem solely from global atomospheric radioactive fallout, 90Sr and 137Cs distribution show roughly the same quantitative ratio. Liquid waste from the atomic power stations has led to an increase in the radionuclide content in plants found in the Ol'khovskoe bog peat beds. (Alexander-PTT)
W87-08710

GEOCHEMICAL PARTITIONING OF HEAVY METALS IN SEDIMENTS OF THREE ESTUARIES ALONG THE COAST OF RIO DE JANEIRO (BRAZIL),
Universidade Federal Fluminense, Niteroi (Brazil). Dept. de Geoquimica.
For primary bibliographic entry see Field 2L.
W87-08717

HEAVY METAL POLLUTION IN THE PARAIBA DO SUL RIVER, BRAZIL,
Universidade Federal do Rio de Janeiro (Brazil). Inst. de Biofisica.
W. C. Pfeiffer, M. Fiszman, O. Malm, and J. M. Azcue.
The Science of the Total Environment STENDL, Vol. 58, No. 1/2, p 73-79, December 1986. 1 fig, 4 tab, 10 ref.

Descriptors: *Bioindicators, *Heavy metals, *Path of pollutants, *Paraiba do Sul River, *Sediments, Brazil, Rivers, Metals, Transport, Aquatic plants.

The methodology of critical pathway analysis successfully employed to asses the impact of the nuclear industry has been applied to evaluate the

stable metal pollution in the Paraiba do sul River (PSR), Brazil. Results show that concentrations of four metals (Pb, Cu, Cr and Zn) out of eight released by an industrial park are critical. Bottom sediment and suspended particles are the most contaminated abiotic compartments. Suspended particles are the main compartment for metal transport downstream. The metal concentrations are significantly higher in the surface coatings, which are considered to be the available fraction of suspended particles and bottom sediments, than in the residual fraction. Eichornia azure and Eichornia crassipes, common aquatic plants in the area, can be employed as biological monitors for the critical heavy metals discharged into the PSR. (Author's abstract)
W87-08718

CHLORINATED INSECTICIDES AND PCBS IN ASTEROIDEA AND HOLOTHUROIDEA SPECIES FROM RIJEKA BAY, YUGOSLAVIA,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
N. Picer, and M. Picer.
The Science of the Total Environment STENDL, Vol. 57, p 39-47, December 1986. 2 fig, 4 tab, 20 ref.

Descriptors: *Bioaccumulation, *Path of pollutants, *Chlorinated insecticides, Polychlorinated biphenyls, *Asteroidea, *Holothuroidea, *Rijeka Bay, Sediments, DDT, Tissue analysis.

For an evaluation of the extent of pollution in Rijeka Bay, Yugoslavia by chlorinated hydrocarbons an investigation of levels in sediments and the most abundant benthic organisms (Asteroidea and Holothuroidea species) has been carried out. Samples were collected at several stations in October 1981. The concentrations of chlorinated insecticides and polychlorinated biphenyls (PCBs) in Asteroidea species were from 0.5 to 46.0 microgram(ug)/kg for DDT sub total, and from 2.5 to 435 ug/kg (wet weight) for PCBs. For the PCBs in Holothuroidea species the values ranged from 4.4 to 37.2 ug/kg and for DDT sub total from 0.9 to 48.5 ug/kg. The contamination of Asteroidea and Holothuroidea samples from Rijeka Bay with persistent chlorinated hydrocarbons was compared with other data for the same species from other parts of the world. Accumulation of chlorinated hydrocarbons by Asteroidea and Holothuroidea species from sediments of Rijeka Bay is discussed with respect to concentration factors (CF). The highest CF (70.0) (dry biota/dry sediment) was obtained for the intestines of Asteroidea species for PCBs and a value of only 2.6 was obtained for DDT sub total for the skin and muscle of Holothuroidea species. The relatively low bioaccumulation of PCBs and DDTs from sediments in the Rijeka Bay by the Asteroidea and Holothuroidea species is reassuring, because of the problem of dredging and ocean dumping of sediments polluted with persistent chlorinated hydrocarbons. (Author's abstract)
W87-08724

SOME METALS AND THEIR POSSIBLE SOURCES IN RAIN WATER OF THE SOUTHERN BALTIC COAST, 1976 AND 1978-1980,
Medical Academy, Gdansk (Poland). Dept. of Analytical Chemistry.
P. Szefer, and K. Szefer.
The Science of the Total Environment STENDL, Vol. 57, p 79-89, December 1986. 1 fig, 7 tab, 21 ref.

Descriptors: *Water pollution sources, *Metals, *Rainfall, *Baltic coast, *Atomic absorption spectroscopy, Seasonal variation, Regional variation, Heavy metals.

Samples of rain water collected at three sites on the Baltic coast were analyzed for iron, manganese, lead, copper, cadmium, nickel, cobalt, calcium, magnesium, sodium and potassium by atomic absorbtion spectroscopy (AAS); uranium and thorium were determined spectrophotometrically with Arsenazo III. A regional and seasonal-dependent variability of some metal concentrations in rain water was observed. Sodium, potassium, magnesium and cobalt existed in water mainly as dissolved forms, while lead, iron, uranium and thorium were generally contained within suspended matter. Considering the concentration of each metal relative to iron and sodium as normalizing elements, three groups of metals can be distinguished, i.e., a marine source for sodium; a terrestrial source for iron, magnesium, potassium, uranium, thorium, manganese and nickel; and an anthropogenic source for lead, cadmium, copper and cobalt. (Author's abstract)
W87-08726

MERCURY POLLUTION IN MARINE SEDIMENT CORES NEAR CINNABAR DEPOSITS AND A CHLOR-ALKALI PLANT,
Siena Univ. (Italy). Dipartimento di Biologia Ambientale.
F. Baldi, and M. L. D'Amato.
The Science of the Total Environment STENDL, Vol. 57, p 111-120, December 1986. 7 fig, 20 ref. CEC Grant ENV-512(I)S.

Descriptors: *Path of pollutants, *Mercury, *Marine sediments, *Cinnabar, *Tyrrhenian Sea, Coastal waters, Carbonates, Heavy metals, Sediments, Distribution, Organic matter.

Three sediment cores were sampled from the continental shelf of the Tyrrhenian Sea close to two areas contaminated by mercury from two different sources: the cinnabar deposits of southern Tuscany, and the outlet of a chlor-alkali plant at Rosignano Solvay (Livorno). The accumulation of mercury in marine sediment cores is influenced mainly by the high carbonate content of both natural and industrial origin. The grain-size of sediment particles plays an important role in the distribution of mercury in one core (CB 7), in which the highest concentration is associated with the coarse fraction, indicating that the mercury is mainly in the form of cinnabar (HgS). Because of the lack of variability in the abundance of organic matter in the sediment, except at the top of the core, its influence on mercury distribution could not be determined. We have tentatively calculated the sedimentation rate (0.82 cm/year) in one core (RO 14) by means of the peaks of the carbonates and mercury concentrations combined with data supplied by the chemical company. The results show that in both areas over the last decade mercury concentrations have decreased significantly. (Author's abstract)
W87-08727

QUANTITIES OF CADMIUM, LEAD, MERCURY AND ARSENIC ENTERING THE U.K. ENVIRONMENT FROM HUMAN ACTIVITIES,
King's College, London (England). Monitoring and Assessment Research Centre.
M. Hutton, and C. Symon.
The Science of the Total Environment STENDL, Vol. 57, p 129-150, December 1986. 15 tab, 53 ref.

Descriptors: *Water pollution sources, *Cadmium, *Lead, *Mercury, *Arsenic, *United Kingdom, *Heavy metals, Waste disposal, Discharge, Combustion, Industrial wastes.

This paper presents an estimate of the quantities of cadmium, lead, mercury and arsenic entering the U.K. environment from human activities. Discharges are divided into three source categories: the production and use of the elements, inadvertent sources and various waste disposal practices. The major atmospheric sources of cadmium and mercury include refuse incineration, nonferrous metal production, iron and steel production, fossil fuel combustion and, for mercury alone, the chlor-alkali industry. In contrast, lead and arsenic each have only one major atmospheric source: petrol and coal combustion, respectively. The largest inputs of cadmium, lead and mercury to landfill arise from the disposal of municipal wastes; for arsenic, ash disposal from coal combustion is more important. Industrial activities represent the major sources of trace element input to the U.K. sewage system but domestic sources are important for lead and cadmium, while road run-off makes a considerable lead input. In U.K. coastal waters the major sources of cadmium are the direct discharge of sewage and industrial effluents. For the other elements, the dumping of solid wastes is of more significance. The largest inputs of lead, mercury and arsenic to U.K. agricultural land arise from atmospheric deposition; for cadmium the application of phosphate fertilizers is a more important source, while sewage sludge can be of local significance. (Author's abstract)
W87-08728

COMPOSITION OF SUSPENDED PARTICULATE MATTER FROM SCOTTISH COASTAL WATERS GEOCHEMICAL IMPLICATIONS FOR THE TRANSPORT OF TRACE METAL CONTAMINANTS,
Marine Lab., Aberdeen (Scotland).
P. W. Balls.
The Science of the Total Environment STENDL, Vol. 57, p 171-180, December 1986. 4 fig, 1 tab, 31 ref.

Descriptors: *Path of pollutants, *Coastal waters, *Particulate matter, *Suspended solids, *Scotland, *Heavy metals, Transport, Geochemistry, Irish Sea.

The concentrations of Fe, Mn, Zn, Pb, Cu and Cd have been determined in suspended coastal particulates. Enrichment factors (EF) have been determined with iron as the reference element to identify contaminated particulates. Decreases in EFs between the Irish Sea and west of Scotland are interpreted as being due to a combination of dilution and sedimentation of enriched particulates from the Irish Sea. Particulates from the Firth of Clyde are shown to be enriched in manganese. Trace metal enrichments within the Firth are closely correlated with manganese (but not iron), suggesting that manganese hydroxide coatings are important. The origin of such coatings and the wider implications to coastal geochemistry are discussed. (Author's abstract)
W87-08729

ADSORPTIVE BEHAVIOR OF BUTYLTIN COMPOUNDS UNDER SIMULATED ESTUARINE CONDITIONS,
New Hampshire Univ., Durham. Dept. of Chemistry.
L. Randall, and J. H. Weber.
The Science of the Total Environment STENDL, Vol. 57, p 191-203, December 1986. 3 fig, 3 tab, 22 ref. NSF Grant CEE-81-16960 and EPA Grant R-809416.

Descriptors: *Butyltin compounds, *Adsorption, *Chemical reactions, *Estuaries, Simulation, Seawater, Salinity, Fulvic acids.

Adsorption of BuSnCl3, Bu2SnCl2, and Bu3SnCl were studied under simulated estuarine conditions. The variables included artificial seawater and its dilutions (salinity 5-35 g/kg), pH (6.2-8.2), and hydrous iron oxide concentration (10-1000 mg/L). Fulvic acid concentration was constant at 10 mg/L, and initial concentration of butyltin compounds was 10 ng/ml (as Sn). Adsorption of butyltin compounds varied from 72 to 100% for BuSnCl3, 0 to 56% for Bu2SnCl2, and 57 to 95% for Bu3SnCl. At the 95% confidence level all three variables were significant for BuSnCl3 adsorption, pH was significant for Bu2SnCl2 adsorption, and pH and salinity were significant for Bu3SnCl adsorption. Discussion includes the importance of, and reasons for, differing adsorptive behavior of the three butyltin compounds. (Author's abstract)
W87-08730

TRANSPORT OF ARSENIC AND MERCURY FROM GOLD MINING ACTIVITIES THROUGH AN AQUATIC SYSTEM,
Canada Centre for Inland Waters, Burlington (Ontario). Environmental Contaminants Div.
A. Mudroch, and T. A. Clair.
The Science of the Total Environment STENDL, Vol. 57, p 205-216, December 1986. 2 fig, 5 tab, 14 ref.

Descriptors: *Path of pollutants, *Arsenic, *Mercury, *Gold mining, *Lakes, Limnology, Nova Scotia, Heavy metals, Transport, Sediments.

Past gold mining practices in the Waverley area of Nova Scotia, Canada, have left wastes containing arsenic and mercury which are affecting water and sediment quality in the Shubenacadie River headwater lakes. The concentrations of arsenic and mercury in sediments decreased gradually from 1500 microgram(ug)/g and 40 ug/g near the Waverley mine site to 120 ug/g and 0.5 ug/g, respectively, in a downstream lake. The concentrations of arsenic and mercury were determined in water from the lakes and connecting streams and in suspended solids collected from the connecting streams in the spring, summer and fall of 1983 to investigate means of transport within the headwater lakes. The greatest quantity of arsenic (7.1 kg) was transported by suspended solids in November, while most of the mercury was transported by suspended solids during spring and fall, although the concentration of mercury in all water samples was below the detection limit of 0.0005 mg/L. A significant increase of dissolved iron and manganese concentration was found during summer anoxic conditions in lake bottom waters and in the water of connecting streams. Calculations show that arsenic is most likely associated with iron oxides precipitated after the mixing of iron-rich hypolimnetic water with oxygenated surface lake water, and is transported further downstream by suspended solids. (Author's abstract)
W87-08731

SEASONAL VARIATION OF COPPER AND ZINC CONCENTRATIONS IN THE OYSTER SACCOSTREA CUCCULLATA FROM THE DAMPIER ARCHIPELAGO, WESTERN AUSTRALIA: IMPLICATIONS FOR POLLUTION MONITORING,

Department of Conservation and Environment, Perth (Australia).
V. Talbot.

The Science of the Total Environment STENDL, Vol. 57, p 217-230, December 1986. 2 fig, 4 tab, 15 ref.

Descriptors: *Path of pollutants, *Copper, *Zinc, *Heavy metals, *Oysters, *Seasonal variation, Australia, Monitoring, Reproduction.

The intertidal rock oyster Saccostrea cuccullata, sampled at eight sites on eight occasions over a 1-year period, contained mean Cu and Zn concentrations ranging between 34 and 267 and 206 and 4078 mg/kg dry weight, respectively. In the study area, Cu and Zn emanate from sewage and boat slips (antifouling paints), while Zn probably also originates from coolant water from an electricity power generating station and iron ore exporting facilities. Highest oyster wet weight, Cu and Zn concentrations and loads occurred in January (spawning period), indicating that metal variation was not reciprocating wet weight. Lowest metal concentrations and loads occurred in October (period of onset of gametogenesis), while lowest wet weight occurred in April (post-spawning period). No significant ($P < 0.001$) variation in the wet to dry weight ratio was noted temporally. However, significant, though slight, variation was noted between polluted and unpolluted oysters. Results of this study indicate that pollution control monitoring programs should consider: (i) seasonal variation of metal concentrations; (ii) portion of the year during which standards are exceeded; (iii) oyster size and availability for human consumption; (iv) suitability of standards where shellfish are not consumed as a staple diet; (v) appropriate size indices which can be used for selecting specimens for intersite comparisons; (vi) wet to dry weight calculations: techniques, spatial and temporal variations; and (vii) the physical dynamics of sites used. (Author's abstract)
W87-08732

USE OF BULLFROGS (RANA CATESBEIANA) AS BIOLOGICAL MARKERS FOR 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN CONTAMINATION IN THE ENVIRONMENT,

National Center for Toxicological Research, Jefferson, AR. Div. of Chemistry.

For primary bibliographic entry see Field 5A.
W87-08733

LEACHING LOSSES FROM IRRIGATED PASTURE: WAIAU IRRIGATION SCHEME, NORTH CANTERBURY,

Ministry of Works and Development, Christchurch (New Zealand). Water and Soil Directorate.
M. E. Close, and P. H. Woods.

New Zealand Journal of Agricultural Research NEZFA7, Vol. 29, No. 2, p 339-349, 1986. 3 fig, 6 tab, 16 ref.

Descriptors: *Path of pollutants, *Non-point sources, *Water pollution sources, *Leaching, *Irrigation, *Lysimeters, Nutrients, Nitrogen, Phosphorus, Sulfates, Potassium, New Zealand.

Leaching of solutes from irrigated pasture in the Waiau Irrigation Scheme, North Canterbury was measured using non-weighing lysimeters. During an irrigation season the leashing losses of total nitrogen (nitrate N + total dissolved Kjeldahl N) ranged from 7 to 70 kg N/ha, phosphorus from 0.4 to 4 kg P/ha, sulfate from 7 to 29 kg S/ha, and potassium from 9 to 26 kg K/ha. The distribution of soil nutrients across the irrigation strip was measured. Urine patches resulted in considerable variability in the data, and tended to occur more frequently near the edge of the border strips, probably because of sheep camping. An assessment of average leaching for the Waiau scheme was made. (Author's abstract)
W87-08737

HYDRAULIC/CHEMICAL CHANGES DURING GROUND-WATER RECHARGE BY INJECTION,

Geological Survey, Sacramento, CA. Water Resources Div.
S. N. Hamlin.

Ground Water GRWAAP, Vol. 25, No. 3, p 267-274, May-June 1987. 9 fig, 3 tab, 17 ref.

Descriptors: *Water reuse, *Water quality control, *Water pollution treatment, *Hydraulic conductivity, *Aquifers, *Groundwater recharge, *Reclaimed water, *Injection wells, Clay, Sodium, Ions.

Groundwater recharge by injection of reclaimed water is a feasible method of improving groundwater quality in the shallow aquifer system in the Palo Alto Baylands along the San Francisco Bay. Groundwater was initially more saline than sea water. Reclaimed water was injected at a rate of 10 gallons per minute from June 5, 1980, to July 1, 1980. At the completion of injection, water from an observation well 31 feet from the injection well was 98 percent injected water - in essence, fresh water. An abrupt rise in the water level in the injection well of about 1.5 feet during the initial injection test was the result of a 3.5 percent density difference between injected fresh water and saline groundwater. The arrival of injected water at observation wells showed the same effect, allowing monitoring of chemical and hydraulic changes entirely through water-level data. The initially sodic clays in the confining layer were expected to swell as the saline groundwater (sodium source) was diluted by recharge water. The sodium ion causes excessive coordination with the hydronium ion ($H3O(+)$) in the clay lattice, resulting in expansion as the saline water is diluted. X-ray diffraction analysis of clay samples soaked first in native and then in injected water showed this effect. Calcium replaces sodium and limits expansion. Prior to injection the saline groundwater was super-saturated with calcite. Dilution, as injection proceeded, eventually produced an undersaturation of calcite. An increase in well specific capacity indicates that calcite dissolved from the aquifer matrix, improving hydraulic conductivity. (Author's abstract)
W87-08751

DISTRIBUTION COEFFICIENT OF TRICHLOROETHYLENE IN SOIL-WATER SYSTEMS,

Geosystem Consultants, Inc., Irvine, CA.
M. Mehran, R. L. Olsen, and B. M. Rector.

Ground Water GRWAAP, Vol. 25, No. 3, p 275-282, May-June 1987. 2 fig, 2 tab, 27 ref.

Descriptors: *Path of pollutants, *Trichloroethylene, *Field tests, *Groundwater, Distribution, Organic carbon, Prediction, Organic solvents.

The distribution coefficient of trichloroethylene (TCE) was obtained from field and theoretical methods. The field method was based on measuring TCE concentrations in the soil samples and in the adjacent groundwater. The theoretical method was based on using the organic carbon content of the soil and the octanol/water partition coefficient for TCE. The average distribution coefficient for 19 field samples and four methods of calculation was 0.18 ml/g which is in agreement with literature data and octanol/water partition coefficients results. For soils containing greater than 0.1 percent organic carbon, the theoretical methods of calculating the distribution coefficient appear to be valid. For soils low in organic carbon content, laboratory determinations of the distribution coefficient can provide reasonable estimates for predicting actual migration rates. Field determinations of distribution coefficients are, however, preferred because they integrate the effect of various factors on partitioning of TCE. (Author's abstract)
W87-08752

COMPARISON OF FIELD AND LABORATORY METHODS FOR DETERMINING CONTAMINANT FLOW PARAMETERS,

Toronto Univ., Scarborough (Ontario). Groundwater Research Group.
S. R. Taylor, G. L. Moltyaner, K. W. F. Howard, and R. W. D. Killey.

Ground Water GRWAAP, Vol. 25, No. 3, p 321-330, May-June 1987. 11 fig, 3 tab, 21 ref.

Descriptors: *Groundwater movement, *Field tests, *Path of pollutants, *Comparison studies, *Solute transport, *Tracers, Aquifers, Hydraulic conductivity, Sand, Grain size, Dispersivity.

In situ estimates of advective and dispersive properties of groundwater flow systems are essential for the adequate prediction of solute flow. Field tracer tests provide the best estimates of these properties; however, this approach is often precluded by the expense and time involved. Various laboratory techniques have been developed to circumvent these problems and provide convenient estimates of hydraulic conductivity and dispersivity. Although these techniques are used extensively in hydrogeological investigations, very few attempts have been made to compare their estimates with field values. A detailed investigation was performed on an unconfined sand aquifer using a combination of routine laboratory techniques and an innovative field tracer test. The extensive data set provided a unique opportunity to compare field results with those obtained by a variety of laboratory techniques. The hydraulic conductivity results from two different methods of grain-size analysis were observed to be quite well correlated, although their absolute values did not correspond with the hydraulic conductivities determined from the tracer test. However, contrary to previous studies, the results from grain-size analysis were the same order of magnitude as the in situ values. In addition, the two grain-size methods appear to provide upper and lower boundaries within which lie the hydraulic conductivity estimates determined from the tracer test. Thus, grain-size analysis of moderately to well sorted sands may provide reasonable and convenient approximations of hydraulic conductivities of the aquifer. No correlation was observed between field tracer test longitudinal dispersivity values and those determined from laboratory column tracer tests. The latter, however, differed by only an order of magnitude from the in situ point measurements, a difference which is considerably smaller than has been previously reported. This is largely attributed to the accuracy of the sampling methods used in the tracer tests. (Author's abstract)
W87-08757

IMPACT OF THE DUPUIT-FORCHHEIMER APPROXIMATION ON SALT-WATER INTRUSION SIMULATION,

Kansas State Geological Survey, Lawrence.

For primary bibliographic entry see Field 2F.

W87-08758

PERFORMANCE AND ANALYSIS OF AQUIFER TRACER TESTS WITH IMPLICATIONS FOR CONTAMINANT TRANSPORT MODELING - A PROJECT SUMMARY,
Auburn Univ., AL. Dept. of Civil Engineering.
F. J. Molz, O. Guven, J. G. Melville, and J. F. Keely.
Ground Water GRWAAP, Vol. 25, No. 3, p 337-341, May-June 1987. 7 fig.

Descriptors: *Groundwater movement, *Groundwater pollution, *Aquifer testing, *Path of pollutants, *Tracers, *Model studies, *Dispersivity, Hydrodynamics, Artifacts, Velocity, Simulation, Calibrations, Prediction.

The scale-dependence of dispersivity values used in contaminant transport models to estimate the spreading of contaminant plumes by hydrodynamic dispersion processes was investigated and found to be an artifact of conventional modeling approaches (especially, vertically averaged parameters in two-dimensional plume simulations). The work reported here shows that variations in hydraulic conductivity with depth result in significant variations in groundwater flow and contaminant transport velocities; it is the resulting velocity variations that, if vertically averaged, give rise to apparent scale-dependency of dispersion (e.g., increased dispersion with increasing travel distance). Special depth-selective observation well designs are recommended by the authors for use in tracer tests, so that detailed estimates of the variations in hydraulic conductivity, and flow and transport velocities can be obtained. Innovative modeling techniques that take advantage of the detailed information obtainable from such tests (by emphasizing advective transport, as opposed to dispersive transport), have been developed by the authors. These modeling techniques are shown to have an element of true predictive ability, being able to closely simulate actual results with little or no calibration. (Author's abstract)
W87-08759

MANAGING POWERPLANT COMBUSTION WASTES,
For primary bibliographic entry see Field 5E.
W87-08803

PROFILES OF NITROGEN SPECIES IN A SAND-SILT AQUIFER AT HASLEMOEN, SOLOR, SOUTH NORWAY,
Agricultural Univ. of Norway, Aas.
J.-O. Englund, and S. Haldorsen.
Nordic Hydrology NOHYBB, Vol. 17, No. 4/5, p 295-304, 1986. 4 fig, 2 tab, 13 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Nitrogen, *Nitrates, *Groundwater, *Aquifers, Sand aquifers, Chemical analysis, Vadose water, Norway, Haslemoen, Monitoring, Pore pressure, Permeability coefficient, Forests, Agriculture, Profiles.

Chemical profiles of water in the vadose zone and in the upper part of the groundwater from a water-table sand-silt aquifer at Haslemoen, South Norway, were studied. Filter tips attached to steel pipes (BAT monitoring system) were installed to different depths at two localities. The system makes it possible to measure pore pressures and hydraulic conductivities and to take samples under controlled conditions both above and below the groundwater level. One locality is characterized by forest, groundwater level at about 7 meters below the surface, and filter tips down to 13.2 meters. Agricultural land surrounds the field installations at the other locality, with groundwater level about 4.5 meters below the surface, and filter tips down to 10.4 meters. The chemical data demonstrate: (1) higher concentrations of both total nitrogen and nitrate below agricultural land; (2) decreasing concentrations downwards of both total nitrogen and nitrate in both profiles; and (3) iron and/or organic carbon seems to take part in the reduction of nitrate, probably to free nitrogen. (Author's abstract)

W87-08818

LABORATORY EXPERIMENTS ON SOLUTE TRANSPORT IN NON-HOMOGENEOUS POROUS MEDIA,
Technical Univ. of Denmark, Lyngby.
A. Refsgaard.
Nordic Hydrology NOHYBB, Vol. 17, No. 4/5, p 305-314, 1986. 6 fig, 1 tab, 5 ref.

Descriptors: *Path of pollutants, *Groundwater movement, *Solute transport, *Solutes, *Groundwater, *Soil properties, *Soil physical properties, Permeability coefficient, Porosity, Soil porosity, Heterogeneity, Theoretical analysis, Mathematical equations, Mathematical studies, Experimental data, Comparison studies.

Solute transport in groundwater is a process which has become of major importance during the last decades due to increasing contamination of groundwater. This process usually occurs in a medium heterogeneous with respect to hydraulic conductivity and porosity, properties that affect the dispersion of the solutes. An experimental investigation was described of the solute transport process in heterogeneous porous media, especially the connection between the statistical properties of their hydraulic conductivity distributions and the dispersion parameters governing the spreading of the solutes. The experimental results are compared to theoretical solutions derived for the same case of a solute pulse in an average uniform flow through a heterogeneous porous medium. Generally there is good agreement between the theory and the experiments. In field applications this means that the dispersion parameters can be more readily determined from the soil properties. Furthermore, the deviations between dispersivities found under field conditions can be explained quantitatively by the differences in the length scales and in the variances of the hydraulic conductivity distributions. (Author's abstract)
W87-08819

STOCHASTIC MODELLING OF A CONTAMINATED AQUIFER: THE UNCONDITIONAL APPROACH,
Technical Univ. of Denmark, Lyngby.
D. Van Rooy.
Nordic Hydrology NOHYBB, Vol. 17, No. 4/5, p 315-324, 1986. 8 fig, 10 ref.

Descriptors: *Groundwater pollution, *Waste disposal, *Aquifers, *Path of pollutants, *Model studies, *Water pollution, Solute transport, Mathematical studies, Mathematical models, Mathematical equations, Leachates, Landfills, Geostatistics, Monte Carlo Method, Transmissivity, Stochastic process, Zealand, Denmark, Simulation, Kriging.

A stochastic solute transport model is applied to a case of groundwater contamination in Zealand, Denmark. The contamination is caused by leachate from an unprotected landfill situated in a highly-permeable unconfined aquifer. The stochastic model combines the geostatistical techniques of semivariogram analysis and kriging with a numerical solute transport model. A Monte Carlo approach using the turning bands technique to generate transmissivity fields is chosen. Some preliminary results of the unconditional stochastic simulations are presented. The contaminant plume is characterized by expected concentrations of chloride and standard deviations which can be interpreted as uncertainties related to unknown spatial variations in the transmissivity distribution. (Wood-PTT)
W87-08820

EFFECT OF FERTILIZATION WITH MUNICIPAL SLUDGE ON THE GLUTATHIONE, POLYAMINE, AND CADMIUM CONTENT OF COLE CROPS AND ASSOCIATED LOOPERS (TRICHOPLUSIA NI),
New York State Coll. of Agriculture and Life Sciences, Ithaca. Boyce Thompson Institute for Plant Research.
For primary bibliographic entry see Field 5C.
W87-08835

HEAVY METAL POLLUTION OF THE MID-CANAL OF KANDY: AN ENVIRONMENTAL CASE STUDY FROM SRI LANKA,
Peradeniya Univ. (Sri Lanka). Dept. of Geology.
For primary bibliographic entry see Field 5C.
W87-08840

EFFECT OF INGESTED BENZO(A)PYRENE AND CADMIUM ON TISSUE ACCUMULATION, HYDROXYLASE ACTIVITY, AND INTESTINAL MORPHOLOGY OF THE BLACK SEA BASS, CENTROPRISTIS STRIATA,
National Marine Fisheries Service, Charleston, SC. Charleston Lab.
For primary bibliographic entry see Field 5C.
W87-08842

AGE-DEPENDENT LUNG DOSES FROM INGESTED 222RN IN DRINKING WATER,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5C.
W87-08844

TREES AS INDICATORS OF SUBTERRANEAN WATER FLOW FROM A RETIRED RADIOACTIVE WASTE DISPOSAL SITE,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5A.
W87-08845

LIMITS OF BIOACCUMULATION OF ORGANIC PIGMENTS IN FISH: THEIR RELATION TO THE PARTITION COEFFICIENT AND THE SOLUBILITY IN WATER AND OCTANOL,
Ecological and Toxicological Association of the Dyestuffs Manufacturing Industry, Basel (Switzerland).
R. Anliker, and P. Moser.
Ecotoxicology and Environmental Safety EESADV, Vol. 13, No. 1, p 43-52, February 1987. 2 fig, 2 tab, 22 ref.

Descriptors: *Bioaccumulation, *Pigments, *Organic compounds, *Solubility, *Dyes, *Water pollution effects, *Biological magnification, *Path of pollutants, *Fish, Accumulation, Water pollution, Chemical properties, Lipids, Toxicity.

The reliable experimental determination of the partition coefficient (P sub OW) of organic pigments is hampered by the extremely low water solubilities of these compounds. Therefore, P sub OW values and water solubilities were calculated for 11 typical organic pigments and some disperse dyes. Calculated P sub OW values of the pigments were very high, predicting bioaccumulation factors (BF) several orders of magnitude above 100. Based on recent studies confirming that n-octanol stimulates lipids in their solubilizing effect on organic chemicals, the solubilities of these organic pigments in n-octanol were measured in order to estimate their potential for lipid storage. The very low solubility values indicate that, in spite of the very high predicted BF, such pigments cannot build up dangerous concentrations in lipids (hence in fish), considering their relatively low toxicity and the extremely small amounts entering the environment. It is concluded that there should be no need to perform a fish bioaccumulation test for assessing the bioaccumulation potential of such compounds, provided they show solubility characteristics comparable to those of the pigments investigated in this study. (Author's abstract)
W87-08853

COMPARATIVE KINETICS FOR BIOACCUMULATION OF POLYCHLORINATED BIPHENYLS BY THE POLYCHAETE (CAPITELLA CAPITATA) AND FISH (MUGIL CEPHALUS),
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
G. R. Shaw, and D. W. Connell.
Ecotoxicology and Environmental Safety EESADV, Vol. 13, No. 1, p 84-91, February 1987. 3 fig, 2 tab, 12 ref.

Descriptors: *Bioaccumulation, *Kinetics, *Polychlorinated biphenyls, *Polychaetes, *Mullet, *Path of pollutants, *Biological magnification, Annelids, Fish, Sediments, Mathematical studies, Lipids, Chemical analysis, Aroclors, Interstitial water, Solubility.

The bioaccumulation of Aroclors 1242, 1254, and 1260 from sediments by the polychaete (Capitella capitata) and from water by the mullet (Mugil cephalus) was measured in aquarium experiments and followed by clearance investigations, permitting calculation of the bioaccumulation factor (K sub B), uptake rate constant (k sub 1), clearance rate constant (k sub 2), and derived half-life (t sub 1/2). The k sub 2 and t sub 1/2 values were of comparable magnitude for each organism, but k sub 1 and K sub B values, calculated for polychaetes on the basis of PCB concentrations in whole sediment, were considerably lower. Using the Freundlich equation, an expression was developed for K sub B, assuming that uptake occurred from interstitial water. This expression required the use of empirically developed constants for sedimentary characteristics, but gave values for k sub 1 and K sub B comparable to the values obtained with the fish. (Author's abstract)
W87-08856

COMPARATIVE METABOLISM OF FENITROTHION IN AQUATIC ORGANISMS: I. METABOLISM IN THE EURYHALINE FISH, ORYZIAS LATIPES AND MUGIL CEPHALUS,
Sumitomo Chemical Co., Ltd., Takarazuka (Japan). Takarazuka Research Center.
Y. Takimoto, M. Ohshima, and J. Miyamoto.
Ecotoxicology and Environmental Safety EESADV, Vol. 13, No. 1, p 104-117, February 1987. 4 fig, 3 tab, 18 ref.

Descriptors: *Water pollution effects, *Metabolism, *Fenitrothion, *Path of pollutants, *Bioindicators, *Aquatic environment, *Killifish, *Mullet, *Fish physiology, *Bioaccumulation, *Biotransformation, Environment, Fish, Animal physiology, Salinity, Chemical properties, Accumulation, Temperature, Water temperature, Physical properties, Hydrolysis, Chemical reactions, Pesticides, Organophosphorus pesticides, Insecticides, Toxicology, Bioassay, Assay, Isotope studies.

The metabolism and accumulation of the insecticide fenitrothion was studied in killifish (Oryzias latipes) and mullet (Mugil cephalus). (C14) fenitrothion at 0.1 ppm in running water was more rapidly absorbed in the killifish at 25 than at 15 C to a similar plateau level, and bioaccumulation ratios of fenitrothion were found to be 235 and 339, respectively. Water of higher salinity (23‰) resulted in slightly higher accumulation ratios of fenitrothion in both killifish (303) and mullet (179) than fresh water (235 and 30, respectively), but the half-lives are independent of temperature and salinity, with values of 0.24-0.36 day. Fenitrothion was metabolized primarily through hydrolysis by the killifish, demethylation by the mullet, and conjugation of the liberated phenol with glucuronic acid by both species. Although metabolism of the compound was not affected by the different salinities and temperatures in both fish, the glucuronide conjugate was more directly excreted into water under lower temperature and higher salinity. C14-labeled compounds are distributed primarily in the gall bladder, as indicated by whole-body radioautography. (See W87-08860 and W87-08861) (Author's abstract)
W87-08859

COMPARATIVE METABOLISM OF FENITROTHION IN AQUATIC ORGANISMS: II. METABOLISM IN THE FRESHWATER SNAILS, CIPANGOPALUDINA JAPONICA AND PHYSA ACUTA,
Sumitomo Chemical Co., Ltd., Takarazuka (Japan). Takarazuka Research Center.
Y. Takimoto, M. Ohshima, and J. Miyamoto.
Ecotoxicology and Environmental Safety EESADV, Vol. 13, No. 1, p 118-125, February 1987. 3 fig, 1 tab, 9 ref.

Descriptors: *Water pollution effects, *Bioindicators, *Fenitrothion, *Aquatic environment, *Bioaccumulation, *Metabolism, *Biotransformation, *Snails, *Path of pollutants, Mollusks, Pesticides, Organophosphorus pesticides, Insecticides, Accumulation, Flow, Tissue analysis, Hydrolysis, Chemical reactions, Sulfates, Glucose, Excretion, Liver, Environment, Animal physiology, Isotope studies.

The metabolism of the insecticide fenitrothion was studied in the freshwater snails Cipangopaludina japonica and Physa acuta. The concentrations of fenitrothion and C14 in the snails reached equilibrium on day 1 of exposure to 0.1 ppm (C14) fenitrothion in a dynamic flow system. The maximum bioaccumulation ratios of fenitrothion were 18 and 53 in C. japonica and P. acuta, respectively. These species metabolized the compound primarily by demethylation, hydrolysis, and reduction. The liberated phenol moiety was conjugated with sulfate in C. japonica and mainly with glucose in P. acuta. When the snails were transferred to a freshwater stream, fenitrothion and its metabolites were rapidly excreted, the half-life of the parent compound being < 0.5 day in both species. Whole-body radioautography of P. acuta revealed that fenitrothion and its decomposition products in P. acuta were distributed mainly in the liver. (See W87-08859 and W87-08861) (Author's abstract)
W87-08860

COMPARATIVE METABOLISM OF FENITROTHION IN AQUATIC ORGANISMS: III. METABOLISM IN THE CRUSTACEANS, DAPHNIA PULEX AND PALAEMON PAUCIDENS,
Sumitomo Chemical Co., Ltd., Takarazuka (Japan). Takarazuka Research Center.
Y. Takimoto, M. Ohshima, and J. Miyamoto.
Ecotoxicology and Environmental Safety EESADV, Vol. 13, No. 1, p 126-134, February 1987. 4 fig, 2 tab, 18 ref.

Descriptors: *Water pollution effects, *Metabolism, *Fenitrothion, *Aquatic environment, *Biotransformation, *Waterfleas, *Shrimp, *Bioaccumulation, *Bioindicators, *Path of pollutants, Environment, Pesticides, Organophosphorus pesticides, Insecticides, Crustaceans, Equilibrium, Accumulation, Oxidation, Hydrolysis, Chemical reactions, Sulfates, Glucose, Tissueanalysis, Excretion, Animal physiology, Isotope studies.

The metabolism of the insecticide fenitrothion was studied in the waterflea Daphnia pulex and the shrimp Palaemon paucidens following exposure to 1.0 ppb (C14)fenitrothion in a flowthrough system. The concentrations of fenitrothion and C14 in the crustaceans reached equilibrium, and the maximum bioaccumulation ratios of fenitrothion were 71 and 6 in the daphnia and shrimp, respectively. These species metabolized the compound primarily by oxidation of P=S to P=O, hydrolysis of P-O-aryl linkage, and demethylation. The liberated phenol moiety was conjugated with sulfate in the daphnia and with glucose in the shrimp. When the animals were transferred to a freshwater stream, fenitrothion and its metabolites were rapidly excreted, the half-life of the parent compound being < 0.2 day in both species. (See W87-08859 and W87-08860) (Author's abstract)
W87-08861

VERTICAL TRANSPORT OF HEAVY METALS BY SETTLING PARTICLES IN LAKE ZURICH,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
L. Sigg, M. Sturm, and D. Kistler.
Limnology and Oceanography LIOCAH, Vol. 32, No. 1, p 112-130, January 1987. 5 fig, 4 tab, 35 ref.

Descriptors: *Limnology, *Vertical flow, *Heavy metals, *Sedimentation, *Particulate matter, *Lake Zurich, *Solute transport, *Path of pollutants, Trace metals, Copper, Zinc, Lead, Cadmium, Chromium, Strontium, Chemical properties, Organic matter, Calcium carbonate, Manganese, Iron, Oxides, Seasonal variation.

Transport into sediments of the trace elements Cu, Zn, Pb, Cd, Cr, and Sr by settling particles was investigated in Lake Zurich; the concentrations of these elements in settling particles collected in sediment traps and in the water column were determined at different times of the year. Correlations of trace element concentrations with the various main components of the settling particles (biological material, calcium carbonate, manganese and iron oxides, silicate minerals) and examination of seasonal variations both of these concentrations in particles and of particle fluxes to the sediments show that biological material is an important carrier phase (especially for Cu and Zn). Iron and manganese oxides also contribute to trace element transport, while calcium carbonate is inefficient as a carrier material. (Author's abstract)
W87-08869

USE OF THE POCKETBOOK MUSSEL, LAMPSILIS VENTRICOSA, FOR MONITORING HEAVY METAL POLLUTION IN AN OZARK STREAM,
Missouri Department of Conservation, Columbia. For primary bibliographic entry see Field 5A.
W87-08875

GROWTH OF MIXED MICROBIAL POPULATIONS IN GROUND WATER CONTAINING HIGHLY CHLORINATED ORGANIC WASTES,
Louisiana State Univ. Medical Center, New Orleans. Dept. of Microbiology, Immunology, and Parasitology.
W. Pelon, and J. A. Mayo.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 4, p 661-666, April 1987. 6 tab, 9 ref.

Descriptors: *Groundwater pollution, *Fate of pollutants, *Path of pollutants, *Water pollution effects, *Population density, *Growth, *Bacteria, *Chlorinated hydrocarbons, *Organic wastes, *Biodegradation, Groundwater, Water pollution, Hydrocarbons, Wastes, Louisiana, Degradation, Isolation, Waste dumps, Culturing techniques, Density, Aquatic bacteria, Soil bacteria, Aerobic bacteria, Yeasts, Fungi.

Microbial populations capable of growing in organic-saturated groundwater with no added carbon sources were isolated from a petrochemical waste dump site in Baton Rouge, LA. More than 40 volatile and semivolatile compounds have been detected at the site, 10 of them carcinogens. A reaction vessel was inoculated with 2 ml of soil suspensions. Microbial populations proved to be dynamic, changing both quantitatively and qualitatively with time. The majority of isolates were identified as gram-negative aerobes. The later appearance of fermentor types of organisms suggests cross-feeding from organisms arising earlier, indicating, commensalism. Population numbers were substantial considering the nature of the substrate and the fact that growth occurred under a continuous culture system where a part of the population was being removed continually. The potential for microbial biodegradation of oil pollutants and other recalcitrant compounds by microorganisms is discussed. (Doria-PTT)
W87-08878

ORGANOCHLORINE PESTICIDE RESIDUES IN FISH FROM THE SHATT AL-ARAB RIVER, IRAQ,
The University, Basrah (Iraq). Dept. of Environmental Marine Chemistry.
A. A. Z. DouAbul, M. Al-Omar, S. Al-Obaidy, and N. Al-Ogaily.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 4, p 674-680, April 1987. 1 fig, 2 tab, 16 ref.

Descriptors: *Halogenated pesticides, *Limnology, *Tissue analysis, *Fish, *Iraq, *Bioaccumulation, *Path of pollutants, *Rivers, *Pesticides, Accumulation, Organic pesticides, Biological magnification, Water pollution effects, Shad, Chromatography, Gas chromatography, Endrin, Dieldrin, Heptachlor, Chlordane, Lindane.

The background residue levels of organochlorine pesticides were determined in two commercially

important fish species from the Shatt-al-Arab River, Iraq: the cyprinid Barbus xanthopterus, and the Indian shad Tenualosa ilisha. Residues of beta-BHC, DDT, lindane, and chlordane were below detection limits (1 ppb). Endrin was the most prevalent compound, with levels ranging from 1 to 35 ppb (average 16 ppb). Dieldrin was found in 50% of the cyprinids (average concentration 2 ppb); aldrin was not detected, possibly because of conversion to dieldrin. Heptachlor was below the detection limit (1 ppb) in 15% of cyprinids, but occurred at an average concentration of 3 ppb in the other 85%. (Heptachlor has never been used in Iraq, but may occur as a contaminant in chlordane formulations.) Comparisons are presented with data on pesticide residues in Hor al-Hammar Lake and use patterns of the pesticides are discussed. It is concluded that there is no direct input of organochlorine pesticides to the Shatt-al-Arab River; the sole source of these contaminants is believed to be transportation via natural processes. (Doria-PTT)
W87-08880

CADMIUM CONTAMINATION IN AMERICAN LOBSTER, HOMARUS AMERICANUS, NEAR A COASTAL LEAD SMELTER: USE OF MULTIPLE LINEAR REGRESSION FOR MANAGEMENT,
Department of Fisheries and Oceans, Halifax (Nova Scotia). Fisheries and Environmental Sciences.
For primary bibliographic entry see Field 5C.
W87-08882

CADMIUM AND LEAD IN LAKE ONTARIO SALMONIDS,
Rochester Univ. Medical Center, NY. Dept. of Biophysics.
For primary bibliographic entry see Field 2H.
W87-08883

STATISTICAL ASSESSMENT OF A SAMPLING PATTERN FOR EVALUATION OF CHANGES IN MERCURY AND ZINC CONCENTRATIONS IN PATELLA COERULEA,
Institut National de la Sante et de la Recherche Medicale, Nice (France).
For primary bibliographic entry see Field 5A.
W87-08884

METAL-BINDING PROTEIN IN THE PACIFIC OYSTER, CRASSOSTREA GIGAS: ASSESSMENT OF THE PROTEIN AS A BIOCHEMICAL ENVIRONMENTAL INDICATOR,
C. B. Research International Corp., Sidney (British Columbia).
For primary bibliographic entry see Field 5A.
W87-08885

UNDERSTANDING THE ORIGIN OF RADON INDOORS--BUILDING A PREDICTIVE CAPABILITY,
California Univ., Berkeley. Lawrence Berkeley Lab.
R. G. Sextro.
Atmospheric Environment ATENBP, Vol. 21, No. 2, p 431-438, February 1987. 4 fig, 31 ref. EPA/DOE Interagency Agreement DW89930801-01-0 and DOE Contract DE-AC03-76SF00098.

Descriptors: *Radon, *Prediction, *Air pollution sources, *Path of pollutants, *Mathematical studies, *Air pollution, Tracers, Radioactive tracers, Soil water, Soil physical properties, Reviews.

The preliminary work that has been done to identify important soil and building characteristics that influence the migration of radon into buildings are reviewed. Soil is the major source of radon in houses with higher-than-average indoor concentrations. Identifying the estimated 1 to 2 million homes with indoor concentrations exceeding 300 Bq/cu m is a difficult task. Factors that are likely to affect the source strength of radon from soil include the soil radium concentration, the emanating fraction, and soil type and moisture content. A geographically-based predictive method would, ideally, locate areas with the potential for having high indoor radon levels; such areas would then be investigated in more detail. The efficacy of such an approach would depend upon the availability and quality of data for the characterization of soils in terms of both radon availability and radon transport. Although exploration of existing data bases with wide geographic coverage has begun, further research in needed to investigate the validity of the approach and to define a suitable mathematical relationship among the important parameters. (Author's abstract)
W87-08888

EFFECT OF IRRIGATION ON PERSISTENT TOXICITY OF INSECTICIDES APPLIED AS GRANULES TO SOIL TO BROWN PLANT HOPPER AND RICE SWARMING CATERPILLAR,
Kerala Agricultural Univ., Trivandrum (India).
K. S. Pillai, and M. R. G. K. Nair.
Entomon ENTOD5, Vol. 10, No. 1, p 71-74, March 1985. 2 tab, 10 ref.

Descriptors: *Water pollution effects, *Irrigation effects, *Pesticide toxicity, *Insecticides, *Insects, *Path of pollutants, *Carbofuran, *Phorate, *Mephosfolan, *Accumulation, Field tests, Irrigation, Pesticides, Organic pesticides, Carbamate pesticides, Organophosphorus pesticides, Toxicity, Mortality.

Field studies were performed to determine the effect of irrigation at field capacity and 2.5 cm depth of water levels on the uptake and persistence of the insecticides carbofuran, phorate, and mephosfolan against brown plant hopper and rice swarming caterpillar at Kerala State, India. Persistent toxicity (PT) index values for carbofuran and phorate to plant hopper were higher at field capacity level than at 2.5 cm level when applied at tillering stage. At boot leaf stage, PT index values were higher at 21.5 cm water level for carbofuran and phorate, while values were reversed with mephosfolan. Overall persistence was maximum for carbofuran. PT index values for the caterpillar were higher for all three insecticides at field capacity level at both the crop stages and the maximum persistence and toxicity were shown by mephosfolan. (Author's abstract)
W87-08897

MATHEMATICAL MODEL OF SEASONAL AND SPATIAL VARIATION IN PHOSPHORUS CONCENTRATIONS IN LAKE MEMPHREMAGOG, QUEBEC,
McGill Univ., Montreal (Quebec). Dept. of Biology.
G. B. Spiller, and A. N. D. Auclair.
Ecological Modelling ECMODT, Vol. 34, No. 3/4, p 143-166, December 1986. 9 fig, 3 tab, 24 ref. Environment Canada Contract 0SU5-0157.

Descriptors: *Limnology, *Path of pollutants, *Fate of pollutants, *Mathematical models, *Seasonal variation, *Phosphorus, *Quebec, *Lakes, *Epilimnion, *Model studies, Spatial distribution, Prediction, Computers, Eutrophication, Trophic levels, Convection, Mixing, Advection, Mathematical studies, Particle size, Simulation, Simulation analysis, Sediments, Temperature, Wastewater treatment, Tertiary wastewater treatment.

A mathematical model was developed to predict monthly and spatial changes in total phosphorus concentrations in the epilimnion of Lake Memphremagog, a long, narrow lake traversing the Canada-United States border. Computer experiments were designed to elucidate the P loading mechanisms and to assess the effects of tertiary treatment and increased cultural eutrophication. Simulations assuming P release from sediments greatly improved the correspondence between measured and predicted values. Overall correlation and predictability also increased from the initial model if large particle size and rapid settling were assumed. Tertiary treatment resulted in 49% reduction near the source and 24% reduction at the far end of the lake. Little reduction occurred in the summer. A 20% increase in cultural eutrophication indicated an average annual increase of 15% could be expected. Summer P levels increased 25%, indicating the effect was concentrated in the growing season. Sensitivity analysis showed that P loading rate was more important than either sedimentation or P release rates. (Author's abstract)
W87-08899

PRESENCE OF LEGIONELLA IN LONDON'S WATER SUPPLIES,
Thames Water Authority, London (England).
For primary bibliographic entry see Field 5F.
W87-08901

SEASONALITY OF LEGIONELLA ISOLATES FROM ENVIRONMENTAL SOURCES,
South African Institute for Medical Research, Johannesburg. Dept. of Medical Microbiology.
For primary bibliographic entry see Field 2H.
W87-08902

EPIDEMIOLOGICAL EVIDENCE OF LEGIONELLOSIS TRANSMISSION THROUGH DOMESTIC HOT WATER SUPPLY SYSTEMS AND POSSIBILITIES OF CONTROL,
Alexis Carrel Faculty of Medicine, Lyon (France). National Health Lab.
For primary bibliographic entry see Field 5F.
W87-08905

EXPOSURE TO LEGIONELLA IN GERIATRIC INSTITUTIONS,
Assaf Harofeh Medical Center, Zerifin (Israel). Dept. of Microbiology.
I. Boldur, M. Ergaz, G. Mor, R. Kazak, and A. Pik.
Israel Journal of Medical Sciences IJMDAI, Vol. 22, No. 10, p 728-732, October 1986. 3 tab, 21 ref.

Descriptors: *Path of pollutants, *Population exposure, *Hospitals, *Legionella, *Epidemiology, *Public health, Bacteria, Pathogenic bacteria, Diseases, Human diseases, Water pollution sources, Water pollution effects.

A study of seroreactivity to 6 Legionella species was performed in 2 geriatric hospitals, a day club for the aged, and a group of aged with independent life styles. Results revealed a high prevalence of seropositivity in the hospitals. A titer of 1:256 to at least one antigen was obtained in 30.5% of the patients and 35.7% of the staff members from one hospital, 12.1% of the patients and 17.2% of staff from a second hospital, 9.1% of the day club attendants, and in none of the 26 aged living at home. A second study of the possible source of Legionella spp. was performed in 3 geriatric hospitals. Three strains of L. pneumophila were isolated from water, and one water sample was positive for L. pneumophila SG 1-4 by direct immunofluorescence staining only. Although the findings show that Legionella existed at the 2 hospitals, and although the high prevalence of seropositivity indicated intramural exposure, no evidence was found linking these agents to patient illness. (Author's abstract)
W87-08907

CONTAMINATION OF FISH FROM THE FRENCH ZONE OF LAKE LEMAN BY ORGANOCHLORINE COMPOUNDS BETWEEN 1973 AND 1981 (CONTAMINATION DES POISSONS DU SECTEUR FRANCAIS DU LAC LEMAN, PAR LES COMPOSES ORGANOCHLORES ENTRE 1973 ET 1981),
Ministere de l'Agriculture, Paris (France). Laboratoire Central d'Hygiene Alimentaire.
For primary bibliographic entry see Field 2H.
W87-08909

RESIDUES OF ORGANOCHLORINE PESTICIDES IN ENVIRONMENTAL SAMPLES FROM THE SHATT-AL-ARAB RIVER, IRAQ,
Basrah Univ. (Iraq). Marine Science Center.
A. A. Z. DouAbul, H. T. Al-Saad, and H. N. Al-Rekabi.
Environmental Pollution, Vol. 43, No. 3, p 175-187, March 1987. 1 fig, 1 tab, 26 ref.

Descriptors: *Limnology, *Iraq, *Halogenated pesticides, *Tissue analysis, *Bioaccumulation, *Water pollution sources, *Fish, *Path of pollutants, *Shrimp, *Rivers, Pesticides, DDT, Endrin, Dieldrin, Chromatography, Gas chromatography, Drainage, Barbus, Shad, Sediments, Accumulation, Migration, Crustaceans, Pollutant identification, Chemical analysis.

Application of high-resolution gas chromatography has confirmed relatively low residue levels of DDT, endrin, and dieldrin in the Shatt al-Arab River, Iraq. Average concentrations in the edible portion of the cyprinid Barbus xanthopterus were 21, 4, and 2 micrograms/kg wet weight, respectively. Mean values of DDT, endrin, and dieldrin in surface sediments were 5, 40, and 20 micrograms/kg dry weight, respectively. Shrimps from the river contained residues of o,p'-DDT only (average 2 micrograms/kg dry weight). Comparison of these samples with those from an area directly affected by a point source of organochlorine pesticides showed cyprinids of the same age group with significantly higher residue levels, suggesting that there was no direct input of organochlorine pesticides to the river, and that transportation via natural processes such as drainage appear to be the sole source. Higher residue values in Indian shad are attributed to this fish being migratory and having been exposed to these pesticides elsewhere. (Doria-PTT)
W87-08910

EFFECTS OF PH AND SOIL TYPE ON CONCENTRATIONS OF ZINC, COPPER AND NICKEL EXTRACTED BY CALCIUM CHLORIDE FROM SEWAGE SLUDGE-TREATED SOILS,
Rothamsted Experimental Station, Harpenden (England).
J. R. Sanders, and T. M. Adams.
Environmental Pollution, Vol. 43, No. 3, p 219-228, March 1987. 3 fig, 6 tab, 12 ref.

Descriptors: *Hydrogen ion concentration, *Zinc, *Copper, *Nickel, *Calcium chloride, *Sludge, *Soil amendments, *Land disposal, *Path of pollutants, Heavy metals, Acidity, Soil properties, Chemical properties, Soil texture, Soil analysis, Chemical analysis, Sludge disposal, Sand, Clays, Loam, Ion exchange, Cation exchange.

The effects of pH were studied on concentrations of zinc, copper, and nickel extracted by calcium chloride from a clay loam and two sandy loam soils that had been treated with sewage sludge. Concentrations of all the metals increased rapidly as pH decreased below a threshold value ranging from 6.2 to 7.0 for Zn, 6.2 to 7.2 for Ni, and 4.7 to 5.7 for Cu. Both the total concentrations and the threshold pH values were influenced by differences in soil texture and (between the two light-textured soils) by differences in soil cation exchange capacity. The amount of zinc and copper extracted from the mixtures was considerably less than that extracted from the same quantity of sludge alone. (Author's abstract)
W87-08911

ASBESTOS FIBRES INTRODUCE TRACE METALS INTO STREAMWATER AND SEDIMENTS,
British Columbia Univ., Vancouver. Dept. of Soil Science.
H. Schreier.
Environmental Pollution, Vol. 43, No. 3, p 229-242, March 1987. 9 fig, 2 tab, 25 ref.

Descriptors: *Limnology, *Trace metals, *Water pollution sources, *Path of pollutants, *Sumas River, *Sediments, *Streams, *Water analysis, *Asbestos, Chemical analysis, Chemical reactions, Geochemistry, Solute transport, Nickel, Chromium, Cobalt, Manganese, Magnesium, Heavy metals, Landslides.

Asbestos fibers introduced into the Sumas River at Everson, WA by a massive landslide have altered the water quality and sediment conditions in the downstream section of the river. Associated with the fibers are high quantities of Ni, Cr, Co, and Mn which occur as contaminants and isomorphic substitutions in most asbestos materials. A direct link between discharge, asbestos fiber, and Ni concentrations was demonstrated in the water. Trace metal values in the sediments decrease with distance from the point source, although concentrations 20 km downstream of the slide are still significantly higher than levels at a control station unaffected by the slide. Leaching rates of Mg and trace metals from asbestos fibers were studied using organic acids. It is concluded that, since the pH in the streamwater is decreasing from 8.4 to 7.1 in the downstream direction, trace metals release is of concern. (Author's abstract)
W87-08912

FATE OF 14C-LINDANE IN A RICE-FISH MODEL ECOSYSTEM,
Middle Eastern Regional Radioisotope Centre for the Arab Countries, Cairo (Egypt).
I. Y. Mostafa, A. E. El-Arab, and S. M. A. D. Zayed.
Journal of Environmental Science and Health (B) JPFCD2, Vol. 22, No. 2, p 235-243, March 1987. 4 tab, 8 ref. International Atomic Energy RC. 3685.

Descriptors: *Path of pollutants, *Model studies, *Isotope studies, *Lindane, *Fate of pollutants, *Model ecosystems, *Water pollution effects, *Insecticides, *Bioaccumulation, Fish, Rice, Biodegradation.

A model ecosystem has been used to evaluate the impact of 14C-lindane on rice-fish agricultural system. The distribution of 14C-residues among the constituents of the model ecosystem was studied over a period of 90 days. The insecticide was found to be readily absorbed by the roots and translocated to all parts of the rice plant. The peak level in the shoots (26 ppm) and roots (105 ppm) of plants was reached to within three weeks. Lindane was concentrated in fish and residues as high as 90 ppm could be detected after 30 days. The major part of the residues present in the different constituents of the ecosystem could be extracted with hexane and proved to contain solely the parent compound. The data obtained show that lindane possesses a relatively low biodegradability in fish and in rice plant. The insecticide accumulates in fish and rice plant to considerable extent. (Author's abstract)
W87-08915

RESIDUES OF ORGANOCHLORINE CHEMICALS AND CONCENTRATIONS OF HEAVY METALS IN CICONIFORME EGGS IN RELATION TO DIET AND HABITAT,
Institute of Organic Chemistry, Madrid (Spain).
L. M. Hernandez, M. C. Rico, M. J. Gonzalez, M. C. Montero, and M. A. Fernandez.
Journal of Environmental Science and Health (B) JPFCD2, Vol. 22, No. 2, p 245-258, March 1987. 4 tab, 28 ref.

Descriptors: *Path of pollutants, *Bioaccumulation, *Organochlorine compounds, *Heavy metals, *Diets, *Ciconiforme, Birds, Sediments, Food habits, Food chains.

Residues of organochlorine pollutants and heavy metals were determined in 50 aquatic organisms of five species, 31 eggs of four species of wading birds, water, and sediment collected at Donana National Park, (Spain) during the nesting season 1983 and 1984. The species analyzed were the Spanish frog (Rana perezi), the American crayfish (Procambarus clarkii), the grey mullet (Mugil capito), the common carp (Cyprinus carpio), the European eel (Anguilla anguilla), the purple heron (Ardea purpurea), the grey heron (Ardea cinerea), the white stork (Ciconia ciconia), and the little egret (Egretta garzetta). DDE and PCBs were detected in all samples. Alpha-HCH, TDE, DDT, dieldrin, and heptachlor epoxide were also detected, but less frequently. Aldrin, heptachlor, and dichlorobenzophenone were not detected. Hg, Cd, Pb, Cu, and Zn were detected in all samples. The levels of contaminants investigated are generally below the levels known to cause direct effects on survival or reproduction. Biomagnification of the organochlorine pollutants and Hg is clearly illustrated; there is no evidence of accumulation of Cd, Pb, Cu, and Zn along a food chain. (Author's abstract)
W87-08916

TRACE AND NUTRIENT ELEMENT TRANSFER FROM SEWAGE SLUDGE-AMENDED SOIL TO CROPS: A STUDY ON BRASSICA OLERACEA,
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
H. Muntau, G. Crossmann, P. Schramel, M. Gallorini, and E. Orvini.
Fresnius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 326, No. 7, p 634-635, April 1987. 1 fig, 3 tab.

Descriptors: *Nutrients, *Sludge disposal, *Land disposal, *Path of pollutants, *Bioaccumulation, *Brassica, Cabbage, Tissue analysis, Soil analysis, Estimating, Food crops.

Brassica oleracea was used for plant availability studies and the material will also be available for quality control purposes. The cabbage, grown on sludge-amended soil, was harvested and processed to a homogeneous powder. The results of a preliminary test on homogeneity and a broad spectrum of element concentrations determined are reported. The soil around the plants was also collected and examined. Estimates of uptake coefficients C sub crop/C sub soil are given. (Author's abstract)
W87-08917

RESIDUAL EFFECTS OF SEWAGE SLUDGE ON SOYBEAN: I. ACCUMULATION OF HEAVY METALS,
Maryland Univ., College Park. Dept. of Agronomy.
For primary bibliographic entry see Field 5C.
W87-08921

RESIDUAL EFFECTS OF SEWAGE SLUDGE ON SOYBEAN: II. ACCUMULATION OF SOIL AND SYMBIOTICALLY FIXED NITROGEN,
Maryland Univ., College Park. Dept. of Agronomy.
For primary bibliographic entry see Field 5C.
W87-08922

AMMONIUM BICARBONATE-DTPA AND DTPA EXTRACTIONS OF SLUDGE-AMENDED SOILS,
Colorado State Univ., Fort Collins. Dept. of Agronomy.
For primary bibliographic entry see Field 5A.
W87-08923

MOBILITY OF SLUDGE-BORNE 3,3'-DICHLOROBENZIDINE IN SOIL COLUMNS,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
D. Y. Chung, and S. A. Boyd.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 2, p 147-151, April-June 1987. 4 fig, 2 tab, 12 ref. Michigan Allotment Grant Project 372402.

Descriptors: *Fate of pollutants, *Path of pollutants, *Dichlorobenzidine, *Soil columns, *Isotope studies, Tracers, Mineralization, Incubation, Irrigation, Leachates, Solubility.

Fate of the carcinogen 3,3'-dichlorobenzidine (DCB) in sludge-amended soil was evaluated. Carbon-14-labeled DCB was used as a tracer to examine mineralization and mobility of DCB present in sludge. Dichlorobenzidine was shown to be very persistent in soil and sludge-amended soil with < 2% of the added (14C)DCB evolved as 14CO2 during a 182-d incubation. Mobility of DCB was evaluated by using soil columns (5 by 45 cm) that were irrigated with 2.54 cm water/d for 84 d. The total 14C recovered in leachate water was from 0.16 to 0.063% of the total 14C added to the top 15 cm of the soil column at time zero. The strong binding of DCB to soil constituents rendered it highly immobile despite being placed in a sandy soil that was irrigated with large amounts of

water. However, some finite, albeit small, quantity was apparently leached through the soil profile at a relatively constant rate. The immobilization of DCB presumably results from the formation of humus bound DCB presumably results from the formation of humus bound DCB residues and from its low water solubility. (Author's abstract)
W87-08925

CHEMISTRY OF TENSION LYSIMETER WATER AND LATERAL FLOW IN SPRUCE AND HARDWOOD STANDS,
Tennessee Valley Authority, Muscle Shoals, AL. Air Quality Branch.
J. D. Joslin, P. A. Mays, M. H. Wolfe, J. M. Kelly, and R. W. Garber.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 2, p 152-160, April-June 1987. 4 fig, 4 tab, 52 ref.

Descriptors: *Acid rain, *Air pollution effects, *Path of pollutants, *Water analysis, *Lysimeters, *Water chemistry, *Forests, Throughfall, Soil solutions, Streamflow, Acidity, Aluminum, Sulfates, Nitrates.

The concentrations of H(+), NO3(-), SO2(2-), soluble Al, and undissociated acidity were measured in throughfall, soil solution, and streamflow during five rainfall events on two steeply sloping forested sites in the Great Smoky Mountains. The sources and sinks of these chemical species on a spruce-birch (Picea rubens Sarg.-Betula lenta L.) site were compared to those on a hardwood site. The chemistry of water collected in zero-tension lateral flow collectors during storm events was contrasted with water collected at corresponding depths in tension lysimeters. Tension lysimeter samples from the spruce site had much higher concentrations than those from the hardwood site of H(+) (3-7 x), SO4(2-) (1.5-2 x), Al (2-5 x), and undissociated acidity (1.5-2x). Baseflow from a first-order stream draining the spruce site was significantly higher in Al and H(+) and undissociated acidity were throughfall (incident precipitation + canopy sources) and the O horizon; on the spruce site the O horizon was the predominant source of each. Aluminum and SO4(2-) also increased dramatically with passage through the O horizons, especially on the spruce site. Only the spruce site generated appreciable lateral flow. Nitrate, undissociated acidity, and Al concentrations in spruce site lateral flow were not significantly ($p < 0.05$) different from those in corresponding tension lysimeter samples. Electrical conductivity and concentrations of H(+) and SO4(2-), however, were higher in lateral flow from spruce site B horizons than in corresponding tension lysimeter water. Reduced soil contact time and contact surface area were hypothesized reasons for the ineffectiveness of these B horizon sinks with regard to rapid lateral flow. Lateral flow pathways on the spruce site may have also bypassed sinks for Al and undissociated acidity that exist in the lower mineral horizons and bedrock zone. Stream pH depressions during stormflow may be related to rapid subsurface flow and interflow emanating from these acidic spruce-birch sites. (Author's abstract)
W87-08926

SOYBEAN GROWTH AND BORON DISTRIBUTION IN A SANDY SOIL AMENDED WITH SCRUBBER SLUDGE,
Minnesota Agricultural Experiment Station, St. Paul.
For primary bibliographic entry see Field 5C.
W87-08927

ANALYSIS OF THE IMPACT OF THE SUDBURY SMELTERS ON WET AND DRY DEPOSITION IN ONTARIO,
Ontario Ministry of the Environment, Toronto. Air Resources Branch.
A. J. S. Tang, D. Yap, J. Kurtz, W. H. Chan, and M. A. Lusis.
Atmospheric Environment ATENBP, Vol. 21, No. 4, p 813-824, April 1987. 5 fig, 7 tab, 18 ref.

Descriptors: *Water pollution sources, *Acid rain, *Meteorology, *Smelters, *Ontario, *Air pollution, Sulfates, Deposition, Emissions.

Meteorological analyses of acidic deposition data were undertaken to quantify the effect of Sudbury emissions on precipitation quality and air quality in Ontario during the period 1980-1983 with particular emphasis on the Sudbury smelter shutdown period (July 1982-March 1983). The techniques used included air parcel trajectories and detailed meteorological analysis. Results indicate that the contribution of the Sudbury smelters to sulfate wet deposition in central and southern Ontario was small - less than 12% of the wet deposition at the study sites. The smelter contribution to sulfur dry deposition was greater - possibly as high as 47% of the total at Kapuskasing, and up to about 20-30% of the total in central Ontario, with a smaller contribution (less than 5%) to the southwest and west of Sudbury. These percentages apply to the smelter emission rate in the early 1980s, i.e. about 0.9 million metric tons of SO2 per year. (Author's abstract)
W87-08942

SPATIAL VARIABILITY IN THE CHEMICAL COMPOSITION OF SNOWCOVER IN A SMALL, REMOTE, SCOTTISH CATCHMENT,
University of East Anglia, Norwich (England). School of Environmental Sciences.
M. Tranter, T. D. Davies, P. W. Abrahams, I. Blackwood, and P. Brimblecombe.
Atmospheric Environment ATENBP, Vol. 21, No. 4, p 853-862, April 1987. 6 fig, 5 tab, 47 ref.

Descriptors: *Acid rain, *Acid snow, *Chemistry of precipitation, *Snow cover, *Chemical analysis, *Spatial variation, *Catchment areas, *Scotland, Ions, Distribution, Snow, Solutes.

Fresh snowcover in a remote upland catchment is chemically heterogeneous. Coefficients of variation (Cof) for individual major ions range from 5 to 113%, assuming a normal distribution, or 1 to 144% assuming a lognormal distribution. Aged snowcover is slightly more chemically variable, giving rise to Cof of 19-140%, assuming a normal distribution, or 2-200%, assuming a lognormal distribution. In general, the distribution of the concentration of major ions in snowcover is better described by the lognormal distribution. Both vertical and horizontal variability is observed in the chemical content of within-pack snows. Such heterogeneity has important implications for snowpack sampling. We suggest that rigorous methodologies should be devised for the sampling of fresh snowcover. The sampling of within-pack snows should also be performed under tight statistical constraints if representative estimates of the solute content of snowcover are to be obtained. (Author's abstract)
W87-08945

SEASONAL AND SPATIAL TRENDS IN SOUTH GREENLAND SNOW CHEMISTRY,
New Hampshire Univ., Durham. Inst. for the Study of Earth, Oceans and Space.
P. A. Mayewski, M. J. Spencer, W. B. Lyons, and M. S. Twickler.
Atmospheric Environment ATENBP, Vol. 21, No. 4, p 863-869, April 1987. 3 fig, 3 tab, 34 ref. EPA Contract APP-0306-1983.

Descriptors: *Chemistry of precipitation, *Path of pollutants, *Snow cover, *Spatial variation, *Temporal variation, *Snow chemistry, *Greenland, Chlorides, Nitrates, Sulfates, Sodium, El Chichon, Deposition.

The spatial, temporal, source and physical controls on chloride, nitrate, sulfate and sodium in south Greenland snow are presented based on chemical data from snowpit and fresh snow samples. The snowpit samples cover the period June 1982-June 1984 and the fresh surface snow samples represent one storm event sampled over a 38-km traverse from Dye 3 to the southwest. Oxygen isotope dated records of chloride, sodium, excess sulfate and nitrate are discussed with respect to input timing and source. Notably the anthropogenic influx of excess sulfate is apparent in addition to an influx of excess sulfate that coincides with and is attributed to the arrival of the El Chichon cloud in S Greenland. The El Chichon event is also marked by highs in chloride and nitrate. Examination of fresh surface snow reveals geographic, temperature and moisture controls on deposition. Some excess sulfate close to Dye 3 can be attributed to local pollution. (Author's abstract)
W87-08946

SCAVENGING OF ATMOSPHERIC SULFATE BY ARCTIC SNOW,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2C.
W87-08947

WATER QUALITY BENEATH URBAN RUNOFF WATER MANAGEMENT BASINS,
Agricultural Research Service, Fresno, CA. Water Management Research Lab.
For primary bibliographic entry see Field 2F.
W87-08967

GEOGRAPHIC INFORMATION SYSTEM TO PREDICT NON-POINT SOURCE POLLUTION POTENTIAL,
Nebraska Univ.-Lincoln. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W87-08977

VELOCITY CONTROL AS A TOOL FOR OPTIMAL PLUME CONTAINMENT IN THE EQUUS BEDS AQUIFER, KANSAS,
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 5G.
W87-08982

VACUUM TROUGH EXTRACTORS FOR MEASURING DRAINAGE AND NITRATE FLUX THROUGH SANDY SOILS,
North Dakota Agricultural Experiment Station, Fargo.
For primary bibliographic entry see Field 7B.
W87-08989

SOLUTE TRANSPORT DURING ABSORPTION AND INFILTRATION: A COMPARISON OF ANALYTICAL APPROXIMATIONS,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
For primary bibliographic entry see Field 7C.
W87-08990

ELIMINATION OF TIME ASSIGNMENT BIAS IN ESTIMATES OF DISPERSION COEFFICIENT,
Science and Education Administration, University Park, PA. Northeast Watershed Research Center.
For primary bibliographic entry see Field 7C.
W87-08994

EFFECT OF TILLAGE SYSTEM ON RUNOFF LOSSES OF SURFACE-APPLIED PESTICIDES,
Wisconsin Univ.-Madison. Dept. of Soil Science.
For primary bibliographic entry see Field 2E.
W87-09001

DYNAMICS OF SULFATE RETENTION BY ACID FOREST SOILS IN AN ACIDIC DEPOSITION ENVIRONMENT,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
P. K. Khanna, J. Prenzel, K. J. Meiwes, B. Ulrich, and E. Matzner.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 446-452, March-April 1987. 6 fig, 2 tab, 34 ref.

Descriptors: *Soil water, *Path of pollutants, *Acid rain, *Sulfates, *Acid soil, *Forests, Seasonal variation, Leaching, Spruce, Beech.

The process of input and output of SO4 in spruce and beech forest ecosystems at Solling, West Ger-

many, are dynamic in nature, showing both short term, seasonal cycles and long-term changes. During the observation period (1969-1982), the atmospheric inputs of SO4 were higher for winter than summer periods and for the spruce stand than the beech stand. The respective mean values in kgSO4-S/ha for spruce and beech stands were 53.5 and 28.7 for winter periods and 34.0 and 22.0 for summer periods. Leaching losses of SO4 reflected the amount of drainage water and were usually high during winter (e.g., the mean SO4 values for spruce were 15.8 (summer) and 81.6 (winter) kg S/ha). Leaching losses of SO4 increased significantly after 1975 to 1976 following an acidification phase in these soils. Along with SO4, the concentrations of Al in percolates increased significantly from values < 0.35 mmol of Al prior to 1976 to about 0.60 mmol Al as median values after 1976 on spruce site. Retention or loss of SO4 by these highly acidic soils is explained on the basis of the formation and dissolution of aluminum hydroxy sulfate minerals (e.g., jurbanites; AlOHSO4). AlOHSO4 may exist as an intermediate product in these soils buffering proton concentration, which is ultimately dissolved at low pH values to produce Al and SO4 in soil percolates. The ion-activity product values (IAP) of AlOHSO4 in the soil percolates and the equilibrium soil solutions varied with time (lower and lesser variable values of about 17 on spruce and about 18 on beech after 1976), vegetation (beech vs. spruce) and soil depths (higher values for organic soil horizons than mineral horizons). The relationship between IAP values and the solubility product values has been described in terms of SO4 input to, and SO4 status of these soils. (Author's abstract)
W87-09008

FIRST-ORDER RELIABILITY APPROACH TO STOCHASTIC ANALYSIS OF SUBSURFACE FLOW AND CONTAMINANT TRANSPORT,
California Univ., Berkeley. Dept. of Civil Engineering.
N. Sitar, J. D. Cawlfield, and A. D. Kiureghian.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 794-804, May 1987. 13 fig, 4 tab, 34 ref. NSF CEE-8352147.

Descriptors: *Groundwater movement, *Stochastic process, *Subsurface flow, *Path of pollutants, *Numerical analysis, Probabilistic process, Distribution, Simulation, Statistics.

The first-order reliability method is an attractive approach to stochastic analysis of subsurface flow and contaminant transport. The method can be used with either analytical or numerical solutions, allowing a uniform but flexible approach to solving a variety of problems, and it can fully utilize any level of probabilistic information from the minimum knowledge of second moments to complete knowledge of the full joint distribution. Therefore the first-order reliability method is particularly useful when statistical information is incomplete, as is common for problems in the subsurface environment. Additionally, correlation and nonnormal marginal distributions may be incorporated into the solution. Results from a first-order reliability analysis include an estimate of the probability of exceeding a specified performance criteria and measures of sensitivity of the stochastic solution to changes in random variables and their statistical moments. Three subsurface flow and contaminant transport example problems are used to illustrate the capabilities of the method; results from these examples compare well with previously published Monte Carlo simulation results. (Author's abstract)
W87-09017

MOBILIZATION OF ALUMINUM IN A NATURAL SOIL SYSTEM: EFFECTS OF HYDROLOGIC PATHWAYS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
I. M. Cozzarelli, J. S. Herman, and R. A. Parnell.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 859-874, May 1987. 10 fig, 5 tab, 53 ref. EPA Contract APP-0135-1982.

Descriptors: *Acid rain, *Path of pollutants, *Air pollution effects, *Soil solutions, *Model studies, *Flow models, *Soil water, *Aluminum, Forests, Watersheds, Pores, Lysimeters, Mobility, Hydrology, Nutrients.

Acid input into soil-water systems can mobilize aluminum. A two-component soil water flow model was used in conjunction with an equilibrium speciation model WATEQF to study aluminum mobility in soils of a forested watershed, White Oak Run, in the Shenandoah National Park, Virginia. Soil solution samples, were collected from zero-tension lysimeters designed to collect faster gravitational macropore flow and tension lysimeters designed to collect slower capillary micropore flow. Dissolved aluminum was fractionated into acid-soluble, inorganic monomeric, and organic monomeric aluminum. Soil water aluminum concentrations decreased with depth indicating that the deep soil is a sink for aluminum. All waters contained significant concentrations of acid-soluble aluminum and exhibited a negative correlation between pH and the inorganic monomeric aluminum concentrations. Water in the shallow soil showed distinctly different chemical compositions for the two flow types. Because of its shorter residence time, water flowing in deep soil macropores underwent less extensive neutralization and immobilization of aqueous aluminum than micropore water. Mineral solubility controls water chemistry in the deep soil, while organic substances are the key control in the shallow macropore waters. (Alexander-PTT)
W87-09024

STATISTICAL STRUCTURE AND FILTER CHARACTERISTICS OF TRITIUM FLUCTUATIONS IN FRACTURED BASALT,
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
C. J. Duffy, and J. Harrison.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 894-902, May 1987. 12 fig, 1 tab, 23 ref. NSF Grant CEE-8307982.

Descriptors: *Groundwater movement, *Radioactive waste disposal, *Data interpretation, *Tritium, *Filters, *Fractured basalt, *Path of pollutants, *Groundwater, *Aquifers, Injection wells, Tracers, Radioactive wastes.

The statistical structure and spectral-covariance characteristics of tritium fluctuations are examined from injection of low-level radioactive waste in a fractured basalt aquifer. The tritium fluctuations are the result of a time-varying injection well concentration. The integral scale of the fluctuations increases with distance from the source and the observation well spectra are characteristic of a dispersive-type filter. On the basis of these qualitative attenuation characteristics, a theoretical filter is constructed and transport parameters are estimated. The analysis indicates that environmental tracers may provide a useful extension to controlled tests over large length scales (> 100 m). Although current research has concentrated on the importance of intrinsic variability such as porous media heterogeneities, the present study addresses the control exerted by extrinsic variability as exhibited by source strength fluctuations. (Author's abstract)
W87-09027

SIMULATION OF THE BORDEN PLUME USING THE ALTERNATING DIRECTION GALERKIN TECHNIQUE,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
E. O. Frind, and G. E. Hokkanen.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 918-930, May 1987. 20 fig, 27 ref. NSERC (Canada) Grant A8368.

Descriptors: *Path of pollutants, *Data interpretation, *Galerkin technique, *Borden landfill, Plumes, Chlorides, Groundwater, Aquifers, Dispersion, Simulation, Ontario.

The evolution of the chloride plume at the Borden, Ontario, landfill was simulated and a parametric analysis was performed. The plume is characterized by sharp vertical concentration gradients, indicating a weak transverse vertical dispersion mechanism. To handle the high-resolution grid that is necessary because of the large contrast in the dispersive parameters, the alternating direction Galerkin technique is used. Various types of numerical error that can arise in simulations of such plumes are discussed. The parametric analysis reveals that an approximately three order of magnitude contrast between longitudinal and vertical transverse dispersivities exists in the Borden plume. A variable source concentration function will reproduce the concentration peaks that were observed in the field. However, a growing source concentration function can also produce longitudinal spreading resembling that obtained with a larger longitudinal dispersivity, indicating possible nonuniqueness. The vertical transverse dispersion parameter, which is unaffected by nonuniqueness, is within 1 order of magnitude of molecular diffusion. (Author's abstract)
W87-09030

CHEMICAL CONTAMINANTS IN BOTTOMFISH,
Seattle-King County Dept. of Public Health, WA.
R. M. Nicola, R. Branchflower, and D. Pierce.
Journal of Environmental Health JEVHAH, Vol. 49, No. 6, p 342-347, May/June 1987. 1 fig, 3 tab, 19 ref.

Descriptors: *Bottomfish, *Fate of pollutants, *Water pollution effects, Pollutant identification, Tissue analysis, Fish, Toxicity, Heavy metals, Pesticides, Organic compounds, Inorganic compounds, Public health.

A Tacoma-Pierce County, Washington, Health Department survey of fishermen conducted from June through December 1981 determined the numbers and diversity of people catching bottomfish from the shores of Commencement Bay, in Tacoma, the geographic distribution and the prominent species of fish caught. During the same time period, the Environmental Protection Agency caught bottomfish from four sites along Commencement Bay (the Hylebos Waterway, the City Waterway, the Old Town Dock, and the Point Defiance Dock) and from a control area, Discovery Bay. The edible portion of these fish was analyzed for priority pollutants, heavy metals, and pesticides. Muscle from fish caught in the industrialized environment of Commencement Bay had significantly higher levels of arsenic (14.98 ppm vs 3.157 ppm), copper (.892 ppm vs .510 ppm), cadmium (.017 ppm vs .005 ppm), and zinc (8.03 ppm vs 4.96 ppm) than muscle of fish caught in the relatively pristine Discovery Bay. The risk of acute toxicity due to priority pollutants, heavy metals, and pesticides is low. The risk of toxicity from chronic exposure to these same materials is more difficult to estimate because of a lack of meaningful regulatory health standards and documentation of the chronic toxicity in humans as well as the difficulty in extrapolating animal toxicity to human toxicity. However, comparison of the Commencement Bay data to available national standards led to an advisory warning against consumption of bottomfish from the Hylebos waterway. (Peters-PTT)
W87-09035

GEOCHEMISTRY OF STREAM FULVIC AND HUMIC SUBSTANCES,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2H.
W87-09073

GEOCHEMISTRY OF HUMIC SUBSTANCES IN ESTUARINE ENVIRONMENTS,
Maine Univ., Walpole. Ira C. Darling Center for Research, Teaching and Service.
For primary bibliographic entry see Field 2H.
W87-09074

GROUNDWATER-LEACHATE: MODELING/MONITORING/SAMPLING,
New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
P. N. Cheremisinoff, K. A. Gigliello, and T. K.

O'Neill.
Technomic Publishing Co., Inc., Lancaster, PA. 1984. 146 p.

Descriptors: *Groundwater pollution, *Water pollution sources, *Path of pollutants, *Monitoring, *Leachates, *Model studies, Water sampling, Flow rates, Computers, Landfills, Fate of pollutants.

The contamination of groundwater resources can result from a wide variety of sources (both point and non-point). Realizing the importance of groundwater resources and serious problems caused by its contamination, the United States Congress has mandated several regulatory programs to help protect the nation's groundwater. An essential part of these programs is the required monitoring, sampling and analysis of available data. Required is an understanding of groundwater behavior, direction, rate of flow, extent and concentration of contaminants. These are all preludes to appropriate remedial actions which can be contaminant or removal oriented. This book has been prepared as a guide in development, uses and limitations of groundwater models for predicting movement of contaminated leachate plumes located near solid waste land disposal facilities. Background on monitoring and sampling methodology for such applications, as well as definition and extent of groundwater contamination by leachate generated from solid waste land disposal practices are also covered. The discussion of modeling techniques includes analytical modeling versus digital computer modeling. Actual models are described with references to case histories involving groundwater contamination and predictive modeling methods. Limitations and potential error sources in groundwater modeling is presented. Monitoring systems and sampling particularly applicable to point source contamination as well as for overall investigation of landfill/leachate/groundwater detection and evaluation of quality and problems that may be caused by leachate are presented. Sampling itself is a crucial activity involved with groundwater monitoring. Data derived from monitoring is taken from sample analysis and therefore the quality of the model depends on the quality of the sample. (See also W87-09067) (Lantz-PTT)
W87-09089

FORMATION OF TOXAPHENE-LIKE CONTAMINANTS DURING SIMULATED PAPER PULP BLEACHING,
R. A. Larson, and K. A. Marley.
Research Report 205, UILU-WRC-86-205, September 1986. 23 p, 5 fig, 1 tab, 35 ref. Water Resources Center Project No. S-1000-ILL.

Descriptors: *Toxaphene, *Water pollution sources, *Chlorination, *Pulp and paper industry, *Bleaching wastes, Path of pollutants, Pesticides, Hydrogen ion concentration, Organic compounds.

Toxaphene is a persistent pesticide which is highly toxic to a broad range of organisms including freshwater fish. The sources of Toxaphene are still not clearly understood. Atmospheric transport from the cotton-growing districts of the southeastern United States is presently considered the most plausible hypothesis. This mechanism, however, does not adequately explain all of the data on Toxaphene concentrations in different geographical regions of the U.S. In particular, concentrations in the immediate vicinity of the Great Lakes have been increasing, whereas decreases have been observed at Midwestern sites not near these lakes. It is conceivable that environmental chlorination reactions, not involving the manufacture or application of Toxaphene at all, may be generating materials closely related to or indistinguishable from Toxaphene. The objective of this research was to simulate pulp bleaching conditions in the laboratory, and determine if Toxaphene-like materials could be produced. The aqueous chlorination of the monoterpenes, camphene, limonene, alpha-pinene and beta-pinene produced complex polychlorinated product mixtures. The extent of chlorination was primarily dependent on pH and light conditions. At pH 2 and exposed to sunlight product mixtures were obtained that had striking similarities to Toxaphene. At higher pH or in the dark, less extensive but still substantial chlorination took place; these lower chlorinated compounds could be mistaken for biologically degraded Toxaphene in environmental samples. It is concluded that Toxaphene-like mixtures may conceivably be formed under environmental conditions, but the actual extent of formation of such mixtures and the degree to which they may contribute to apparent Toxaphene in natural samples remain to be assessed. (See also W87-09067) (Author's abstract)
W87-09093

MATHEMATICAL STUDY OF THE IMPACT ON SALINITY INTRUSION OF DEEPENING THE LOWER MISSISSIPPI RIVER NAVIGATION CHANNEL,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
B. H. Johnson, M. B. Boyd, and G. H. Keulegan.
Technical Report HL-87-1, April 1987. Final Report. 72 p, 56 fig, 5 tab, 12 ref.

Descriptors: *Model studies, *Water pollution effects, *Mississippi River, *Saline water intrusion, Mathematical studies, Navigation canals, Salinity, Mathematical models.

One factor being considered in the evaluation of the feasibility of deeper draft access to the ports of New Orleans and Baton Rouge is the impact of a deeper channel on salinity intrusion in the Lower Mississippi River. To address this question, a laterally averaged mathematical model called LAEM that couples the flow and salinity computations through a baroclinic contribution to the longitudinal pressure gradient has been employed for 40-, 45-, 50- and 55-ft channels (with overdepth dredging) using historical low-flow hydrographs. In addition, LAEM has been applied with increased heights of the natural river crossing at river mile 63.4 to determine if such sills provide an effective means of controlling salinity intrusion during critically low-flow periods. A separate question concerning the stability of such sill constructed from natural river sediment dredged from upstream has been addressed by applying the sediment transport model, HEC-6. General conclusions are that an increased channel depth up to 55 ft will result in significant increases in the extent and duration of salinity intrusion during extended low-flow periods. Sills constructed at a crossing by depositing material dredged from upstream appear to provide an effective method for controlling the intrusion of the salt wedge, although tests on a sill at elevation -55 ft indicated the deposited material will be eroded away fairly quickly when the riverflow rises above 400,000 cfs. This will necessitate rebuilding the sill at the onset of each critically low-flow period expected on the Lower Mississippi River. (See also W87-09067) (Author's abstract)
W87-09095

QUALITY OF URBAN RUNOFF,
Camp, Dresser and McKee, Inc., Annandale, VA.
L. A. Roesner.
IN: Urban Stormwater Hydrology, American Geophysical Union, Washington, DC. Water Resources Monograph 7, 1982. p 161-187, 6 fig, 7 tab, 18 ref.

Descriptors: *Urban hydrology, *Urban runoff, *Water quality, *Water pollution sources, *Path of pollutants, *Storm runoff, *Mathematical models, Storm sewers, Combined sewers, Urban drainage, Overland flow, Streamflow, Suspended solids, Suspended sediments, Sediment transport, Water pollution effects.

Even with interceptors, stormwater overflows from combined sewer systems still discharge significant pollution loads to receiving waters. Storm overflows introduce such pollutants as suspended solids, COD, BOD, nitrogen, and phosphorus into receiving waters. Pollutants are introduced into urban runoff from the land surface itself, catch basins, and the sewers in combined systems. Pollutant buildup from urban watersheds increases with the intensity and duration of storms. Mathematical models are presented for calculating the pollution buildup and washoff of pollutants. Pollutographs may be used to estimate the rate of mass transport of a pollutant into the storm sewer system from a single watershed in an urban drainage area. Some ecological water quality models are introduced to assess the effects of stormwater pollutants on aquatic life. (See also W87-09096) (Geiger-PTT)
W87-09102

REPORT OF THE ACID RAIN PEER REVIEW PANEL.
Available from the National Technical Information Service, Springfield, Virginia. 22161, as PB84-246461. Price codes: E02 in paper copy. July 1984. 90 p, 5 append.

Descriptors: *Acid rain, *Path of pollutants, *Water pollution sources, *Water pollution effects, *Air pollution, Cost analysis, Research priorities, Monitoring, Sulfur, Nitrogen, Acidic water, Ecological effects, Environmental effects, International commissions.

The Office of Science and Technology Policy asked a scientific panel on acid rain to complete a peer review of the work on acid depostion in Eastern North America performed by three U. S.-Canadian groups. The panel provided further research and monitoring recommendations to reduce uncertainties in the scientific and technical knowledge regarding acid deposition. Large portions of eastern North America are currently being stressed by wet deposition of acids, by dry deposition of acid-forming substances, and by other air pollutants such as ozone, metals, and organics. Acid deposition has altered the chemistry and biology of aquatic and terrestrial ecosystems of eastern North America. The principal agent altering the biosphere acidity is traceable to man-made sulfur dioxide emission. The panel recommended that cost effective steps to reduce emissions be started now even though the resulting ecological benefits cannot yet be quantified. Highest priority should be given to research on quantifying the effects of acid deposition (both wet and dry) on the total ecological system, distinguishing between the ecological effects of dry and wet deposition of sulfur and nitrogen, differentiating the environmental effects of acid deposition from natural stresses, measuring dry deposition at selected representative sites in eastern North America, and applying tracer methods on a broad scale to study source-receptor relationships. A cost-benefit analysis as it applies to the acid rain problem is discussed in an appendix. (Geiger-PTT)
W87-09107

DETERMINING OPTIMUM PUMPING RATES FOR CREATION OF HYDRAULIC BARRIERS TO GROUND-WATER POLLUTANT MIGRATION,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5G.
W87-09108

LEACHING RADIOACTIVE AND NONRADIOACTIVE ELEMENTS FROM ACTUAL SAVANNAH RIVER PLANT NUCLEAR WASTE GLASS,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
N. E. Bibler.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as DE84-013957. Price codes: A02 in paper copy, A01 in microfiche. Report No. DP-MS--83-133, 1984. 11 p, 5 fig, 2 tab, 5 ref. DOE Contract No. DE-AC09-76SR00001.

Descriptors: *Leaching, *Path of pollutants, *Radioactive wastes, *Glass, *Leachates, Nuclear powerplants, Water pollution, Water pollution sources.

Leaching tests were performed on borosilicate glass containing nonradioactive and radioactive elements in deionized water in the Savannah River Laboratory Shielded Cells Facility. The tests were based on the MCC-1 leaching procedure using stainless steel rather than Teflon baskets. After a designated time in the 90 C oven, the vessel was removed and allowed to cool. The glass was removed and the pH of the leachate was measured.

The concentrations of radionuclides were determined by standard counting techniques and nonradioactive elements were determined by ICP analysis. The pH changes due to leaching were accurately measured for only the 28, 32, and 56 day tests. Leaching results were the same for radioactive and nonradioactive glass. Glass containing actual SRP radioactive waste and glass containing nonradioactive simulated waste leached similarly. Radioactivity did not significantly affect the leaching process by irradiating the glass or the deionized water leachate. Tests with simulated groundwaters are in progress. (Geiger-PTT)
W87-09112

DEVELOPMENT PROGRAMS IN THE UNITED STATES OF AMERICA FOR THE APPLICATION OF CEMENT-BASED GROUTS IN RADIOACTIVE WASTE MANAGEMENT,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5E.
W87-09113

SAFE DRINKING WATER: THE IMPACT OF CHEMICALS ON A LIMITED RESOURCE.
Drinking Water Research Foundation, Alexandria, VA.
For primary bibliographic entry see Field 5C.
W87-09114

BY-PRODUCTS OF CHLORINATION: SPECIFIC COMPOUNDS AND THEIR RELATIONSHIP TO TOTAL ORGANIC HALOGEN,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5F.
W87-09123

OCCURENCE OF CONTAMINATION IN DRINKING WATER FROM GROUNDWATER SOURCES,
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
H. F. Hanson.
IN: Safe Drinking Water: The Impact of Chemicals on a Limited Resource. Lewis Publishers, Chelsea, Michigan. 1985. p 161-166, 5 tab.

Descriptors: *Drinking water, *Groundwater, *Groundwater pollution, *Organic compounds, *Water pollution sources, Water quality control, Groundwater management, Monitoring, Water quality standards, Public health, Pesticides, Inorganic compounds, Water supply, Turbidity, Coliforms.

An estimated 45,000 public groundwater supplies serve more than 100 million people for drinking water purposes in the United States. More than 11 million private wells provide drinking water to an additional 25-30 million residents, mainly in rural areas. Under the Safe Drinking Water Act, the EPA has the authority to establish national standards in the form of maximum contaminant levels (MCLs). About 4,500 groundwater supplies have been reported to exceed the microbiological MCL. Between 1,500 and 3,000 groundwater supplies are in violation of the MCLs for the inorganics including the metals. The major concern with groundwater sources of drinking water is the occurrence of volatile organic chemicals (VOCs). Estimates of the national occurrence of VOCs have been developed from six national surveys conducted over the last several years. In general, the frequency of occurrence of VOC contamination is much greater among larger supplies, although in absolute numbers, more small supplies are expected to be contaminated. Although the data suggest that fewer than 5% of the nation's groundwater supplies have detectable levels of any one specific VOC, an analysis of the data from about 500 randomly selected samples of the Groundwater Supply Survey (GWSS) indicated that 21.2% of the nation's supplies may have at least one VOC present at detectable levels, and that 5.6% have three or more present. A non-random selection of sample sites taken in the GWSS indicated a higher frequency of occurrence (27%) and much higher concentrations. The distribution of organics in drinking water is directly related to use patterns of the specific chemicals. EPA will be analyzing all of these occurrence predictors in order to develop monitoring strategies that can effectively identify and quantify groundwater contamination, and will propose these strategies as part of the pending VOC proposal and the anticipated Advanced Notice of Proposed Rulemaking for the revision of the National Interim Primary Drinking Water standards. (See also W87-09114) (Geiger-PTT)
W87-09125

IMPROVED MONITORING TECHNIQUES TO ASSESS GROUNDWATER QUALITY NEAR SOURCES OF CONTAMINATION,
Environmental Monitoring Systems Lab., Las Vegas, NV.
For primary bibliographic entry see Field 5A.
W87-09126

CHEMISTRY OF NATURAL WATERS,
For primary bibliographic entry see Field 2K.
W87-09149

AMERICAN WEST'S ACID RAIN TEST,
California Univ., Berkeley. Energy and Resources Group.
P. Roth, C. Blanchard, J. Harte, H. Michaels, and M. T. El-Ashry.
World Resources Institute Research Report No. 1, March 1985. 50 p, 17 fig, 9 tab, 74 ref, 3 append.

Descriptors: *Acid rain, *Water pollution sources, *Water pollution effects, Hydrogen ion concentration, Acidity, Air pollution, Public policy, Ecological effects, Environmental effects.

Since 1980, a large body of data on acidic deposition in the West has been developed. The data suggest that individual western source areas could well be adversely affecting sensitive ecosystems downwind. Given that possibility, it is opportune to review the scientific evidence about acidic deposition in the western United States, characterize the potential for damage, assess the scientific uncertainties, and put forth the most significant policy conclusions. Three sets of questions are addressed in the three chapters of this report: (1) How acidic is deposition in the West. Where is acidic deposition observed. How does its acidity compare with that in the East; (2) Which parts of the West are most sensitive to acidic deposition and thus most vulnerable to damages. Have damages been observed; (3) Where in the West are anthropogenic emissions concentrated. How great are these emissions. In magnitude, how do they compare with emissions in the East. Are these emissions increasing or decreasing. Beyond these questions are two others that get at the heart of the practical issues of control strategies and public policy options: (4) Do regions where anthropogenic emissions are large lie upwind of areas where deposition is acidic; (5) What is the extent of overlap between ecologically sensitive regions and locations where deposition is acidic enough to cause damages. Answers to these last two key questions - which together establish the 'source-damage' linkage - are essential to the formulation of effective policies to curb acidic deposition or its effects in the West. Policymakers cannot determine if emissions controls are needed to avert ecosystem damage until scientists first ascertain that acidic deposition occurs at sensitive sites and will cause damage unless something is done to prevent it. In the following sections, the technical issues relevant to policy formulation are discussed and the steps from problem identification and assessment to effective action are spelled out. (Lantz-PTT)
W87-09160

ATMOSPHERIC POLLUTANTS IN NATURAL WATERS.
Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. 512 p. Edited by Steven J. Eisenreich.

Descriptors: *Acid rain, *Air pollution, *Water pollution sources, *Great Lakes, Path of pollutants, Fate of pollutants, Phosphorus, Nitrogen, Carbon, Sulfur, Trace metals, Model studies, Lakes, Trace elements, Aromatic hydrocarbons.

Prior to the last ten years, the principal sources of chemical pollutant input to natural waters were considered to be municipal and industrial discharges (i.e., point sources), and urban and agricultural runoff (diffuse sources). Atmospheric deposition of chemical components to fresh waters was thought not to be quantitatively important except in aquatic systems that received minimal overland drainage and therefore had the atmosphere as its primary input pathway, or in lakes with large surface areas relative to drainage basin area such as the Laurentian Great Lakes. In many cases, atmospheric input of phosphorus, nitrogen and sulfur to soils depleted in these elements was of nutritional value. The atmosphere has been identified as a major input pathway for the introduction of nutrients (P, N, C, S), acidity (H(+)), trace elements (e.g., Cu, Cd, Pb and Hg) and anthropogenic organics (e.g., PCB and PAH) into natural waters. The relative importance of the atmospheric input pathway compared to surface sources depends on the emission strength of other sources. This book is divided into five sections: modeling of atmospheric deposition processes and impact, and the input of nutrients, trace elements and anthropogenic organics to natural waters. Chapters 1-4 describe the processes important in estimating wet, particle and gaseous deposition from the atmosphere. Chapters 5-9 describe the nature and composition of surface microlayers as affected by atmospheric and in-lake processes. Chapters 10-13 summarize the important aspects of phosphorus, nitrogen and sulfur inputs to natural waters. Chapters 14-20 describe the atmospheric input of trace elements to natural waters as reflected in atmospheric fluxes and accumulations in lake compartments (e.g., lake sediments). Chapters 21-24 describe the atmospheric concentrations and depositions of anthropogenic organics to natural waters with particular emphasis on chlorinated organics (e.g., PCB and toxaphene) and polycyclic aromatic hydrocarbons. (See also W87-09165 thru W87-09188) (Lantz-PTT)
W87-09164

MODELING OF ATMOSPHERIC WET DEPOSITION,
Battelle Pacific Northwest Labs., Richland, WA.
B. C. Scott.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 3-21, 8 fig, 2 tab, 13 ref.

Descriptors: *Acid rain, *Water pollution sources, *Model studies, *Wet deposition, *Path of pollutant, Air pollution, Precipitation, Aerosols.

The wet removal rate and wet deposition of pollutants is ultimately dependent upon the rate of pollutant attachment to the falling precipitation particles (hydrometeors) and to the precipitation flux at the ground. If the pollutant materials are present in or attached to aerosol forms, then removal rates will depend strongly upon: solubility of aerosol, size of aerosol, and air concentration of the aerosol. Washout ratios for these aerosols will range over: omicron(100,000) < W < omicron(1,000,000) for rain or warm clouds and W approximately omicron(100,000) for snow or cold clouds, where W = washout ratio. If the pollutant materials are present as vapors, wet removal will depend upon: solubility (Henry's Law), and air concentration of the gas. Washout ratios for those gases will range over: omicron < W < omicron(10,000). (See also W87-09164) (Lantz-PTT)
W87-09165

MODELING OF ATMOSPHERIC PARTICULATE DEPOSITION TO NATURAL WATERS,
Joint Center for Graduate Study, Richland, WA.
S. A. Slinn, and W. G. N. Slinn.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 23-53, 7 fig, 41 ref, append. DOE Contract Y-76-S-06-2227 TA No. 27.

Descriptors: *Path of pollutants, *Model studies, *Air pollution, *Water pollution sources, *Sweden, *Acid rain, Hydrogen ion concentration, Ecosystems, Precipitation, Dry deposition.

Degradation of aquatic ecosystems, caused in part by deposition of atmospheric pollutants, is another

consequence of overpopulation, increased fertilizer usage, fossil-fuel consumption and inadequate pollution controls. Deposition from the atmosphere accounts for as high as 30 to 40% of the total loadings of copper and lead in the Upper Great Lakes. Predictions by extrapolation indicate that the increasing acidity of Swedish rivers and lakes will reach the biologically critical pH value of 5.5 for 60% of the Swedish rivers in 40 years. If the goal of tripling U.S. coal consumption is met during the next 20 years, then the concentration of acid particles in the atmosphere (especially nitrogeneous acids in the Northeastern States) will increase, even if best available pollution control technology is used. The main purpose of this study is to try to remove some of the uncertainties about current estimates for particle dry deposition to water surfaces. These uncertainties arise from significant experimental difficulties and from the large number of potentially important physicochemical processes that can influence particle dry deposition. Review papers conclude that the deposition velocity for 0.1 micrometer particles is expected to be somewhere between 0.01 and 1 cm/sec. In this paper, theoretical analyses are presented that attempt to reduce the uncertainty for particle deposition velocity predictions, and some suggestions are offered for experimental studies to test these predictions. Opportunity is taken to correct the formulation of the dry deposition problem that appears in most earlier publications; basically, the correction is to account properly for fluctuations in particle slip velocity. Transfer by turbulence is considered and limitations to layer or resistance models are described. The theory for the case of dry deposition to smooth, solid surfaces is illustrated. Available water/wind tunnel data are analyzed and peculiarities of the data are noted that should limit their extrapolations to the case of particle dry deposition on natural waters. Predictions for particle dry deposition on natural waters are then made that account for particle growth by water vapor condensation when the particles approach the humid region near the air/water interface. Finally, a brief comparison is made between wet and dry deposition and some field studies are suggested to test the predictions. (See also W87-09164) (Lantz-PTT)
W87-09166

TRANSFER RATES OF GASEOUS POLLUTANTS BETWEEN THE ATMOSPHERE AND NATURAL WATERS,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
D. Mackay, and A. T. K. Yuen.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 55-65, 2 fig, 1 tab.

Descriptors: *Transfer rates, *Air pollution, *Gases, *Path of pollutants, Water pollution sources, Chemical reactions, Diffusion, Henry's Law, Ecosystems, Kinetic reactions, Lakes.

The transfer of pollutants between the atmosphere and natural waters can occur by several mechanisms: fallout in association with rain, snow or particulate matter, spray transfer from breaking waves in the water or from bursting bubbles or by molecular diffusion of the pollutant. This last mechanism is the subject of this paper. Given a natural water body and an atmosphere in contact with it, there are two basic points which must addressed. First, the direction in which diffusive transfer will occur, and second, the speed with which this transfer will occur. Clearly the development of an understanding of the environmental dynamics, fate and effects of pollutants requires addressing these points. Only when the diffusive rate can be quantified, can its importance relative to the other mechanisms be assessed. The basic partitioning or equilibrium properties of the pollutant as characterized by the Henry's Constant H dominate its tendency to migrate between the atmosphere and natural water bodies. Methods of determining H and illustrating its significance graphically have been presented. From a knowledge of H and the environmental concentrations in truly dissolved or gaseous form it is possible to deduce the direction of diffusive transfer. This may or may not be the direction of transfer by other mechanisms such as wet or dry deposition. The kinetic expressions for predicting rate of flux between the phases have been revived and it has been shown that although two resistances apply, often only one is significant, depending on the value of H. It is possible to estimate transfer fluxes or half lives from published mass transfer coefficients although there remains some doubt about the correct values for the coefficient applicable to the near surface resistance of lakes. (See also W87-09164) (Lantz-PTT)
W87-09167

EXCHANGE OF PARTICLES AND GASES ACROSS WATER SURFACES,
Argonne National Lab., IL. Radiological and Environmental Research Div.
R. M. Williams.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 67-78, 5 fig, 6 ref.

Descriptors: *Path of pollutants, *Model studies, *Water surface profiles, *Particle exchange, *Gas exchange, Lakes, Mathematical models, Air-water Interfaces.

Dry transfer of particles and gases to water surfaces is known to be a major component in the mass balance of some chemical species in large lakes, and this process would be expected to become increasingly important as the ratio of water-body surface area to watershed area increases. The development of mathematical models of lakes simulating the transport, removal and effects of airborne contaminants requires knowledge of dry deposition processes and the controlling parameters. This paper discusses the processes by which particles and gases are exchanged between air and water. Particular emphasis is placed on flux measurement considerations. Parameterization of the atmosphere above the water interface is discussed, but it should be remembered that a similar analysis can be applied to the problem of subsurface transfer within the water column. The deposition-velocity formulation coupled with a layered model is a reasonable approach for the analysis of pollutant dry deposition to water surfaces. However, reasonable care must be exercised in the measurement of deposition velocities and in the evaluation of their variations with wind speed, atmospheric stability and surface roughness. Corresponding care must be taken in the application of deposition velocity parameterizations to numerical models. At present there are several analytical models which attempt to describe atmospheric dry deposition to lakes. However, data of sufficient quantity and quality to permit evaluation of these models are lacking. Present understanding does not allow extrapolation of measurements made near the shore to conditions over the lake. In addition, the very difficult problem of flux measurements during winter must be addressed. This season is characterized by higher winds and more unstable conditions, factors which are conducive to enhanced contaminant fluxes. Transfer velocities will have to be measured under these severe conditions in order to develop realistic parameterizations of the deposition process. Future estimates of annual pollutant fluxes can then be made with a few more easily accomplished measurements. (See also W87-09164) (Lantz-PTT)
W87-09168

MECHANISMS OF ENRICHMENT AT THE AIR-WATER INTERFACE,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
A. W. Elzerman.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 81-97, 2 tab, 56 ref.

Descriptors: *Path of pollutants, *Air-water interfaces, *Water surface profiles, *Delaware Salt Marsh, *Enrichment, Zinc, Copper, Iron, Air pollution.

Current efforts are increasingly directed toward understanding the mechanisms or controlling factors of fluxes and enrichment in the surface microlayer. Evidence for some cases in which the mass loading of the surface microlayer is important exist, as in the case of transport of Zn, Cu, and Fe in the Delaware Salt Marsh, or in the case of foams. In any event, a fundamental research prerequisite is determination of the mechanisms and controlling factors of enrichment of toxic materials in the surface microlayer. The objectives of this paper are to: (1) define a set of terms useful for discussing processes at the air-water interface, (2) review and integrate current knowledge about the controlling factors or mechanism of accumulation at the air-water interface, (3) speculate on important processes occurring at the air-water interface in relation to microcontaminants, and (4) attempt to identify research needs. The variability in observed surface environment (SE) of trace metals indicates local sources or processes are important in controlling SE at specific sites. However, some generalizations about groups of samples over widespread areas are possible. SE of trace metals is common, even when a slick is not present. The presence of slicks is correlated with higher fractionation ratio for trace metals, and the increased SE usually occurs in primarily in the particulate phase. Some surface accumulated material is effectively trapped in slicks for significant periods of time and moves with the slick-forming materials on the surface of the water and when foams form. Attraction of polyvalent cations and SE induced by high bulk-water concentrations do not appear to be important mechanisms controlling SE of trace metals. The source and composition of materials entering the surface microlayer (SM) are significant to SE. Atmospheric, bulk-water, and tributary inputs of trace metals to the SM have been identified. The relative proportions of the contribution from each source varies with the specific element and location. (See also W87-09164) (Lantz-PTT)
W87-09169

PRINCIPLES AND PROBLEMS OF MODELING CATION ENRICHMENT AT NATURAL AIR-WATER INTERFACES,
University of East Anglia, Norwich (England). School of Environmental Sciences.
K. A. Hunter, and P. S. Liss.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 99-127, 1 fig, 6 tab, 49 ref.

Descriptors: *Path of pollutants, *Model studies, *Enrichment, *Air-water interfaces, Equilibrium, Organic compounds, Ligands, Salicylic acid, Organic matter.

An equilibrium model for enrichment of metal ions in the microlayer was developed by considering the (theoretical) mass-action equilibrium of surface-active organic compounds acting as ligands for trace metals in competition with the anions of sea water. The model was constructed using the concept of surface excess, since it is essential to balance the excess quantity of metals enriched in the microlayer with the available binding sites on surface-adsorbed organic matter. The model was constructed in such a way that the bulk concentration of trace-metal ions is not required to predict surface excess or EF, since an important feature of experimental results is the relative constancy of EF values with C sub eta varies quite widely. The success of the model developed depends essentially on the relevance of salicylic acid as a suitable model ligand, which cannot be properly assessed at the present time. The arguments developed show, however, that a ligand with stability constants not too different from those of salicylic acid would be able to account for the major features of microlayer results in all marine waters. The important features of the model are the concepts of surface complexation that are involved, and if a ligand having the requisite trace metal selectivity can be found in the microlayer and be demonstrated to exercise control over metal ion enrichment, knowledge of the details of chemical events at the sea surface would be considerably improved. (See also W87-09164) (Lantz-PTT)
W87-09170

ORGANIC MATTER AND HEAVY METAL CONCENTRATIONS IN THE PARTICULATE

PHASE OF LAKE MICHIGAN SURFACE MICROLAYERS,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
P. A. Meyers, R. M. Owen, and J. E. Mackin.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 129-141, 2 fig, 3 tab, 40 ref. NOAA Grant 04-70158-44078.

Descriptors: *Path of pollutants, *Particulate matter, *Heavy metals, *Lake Michigan, *Organic matter, Water surface profiles, Nickel, Copper, Iron, Manganese, Organic carbon, Fatty acids, Hydrocarbons.

The significance of surface films to aquatic ecosystems, atmosphere-hydrosphere exchanges, and geochemical cycles is a topic of widespread interest. It has been observed that the concentration and composition of microlayers can vary substantially within narrow geographic and time limits. This has been found to be equally true of fatty acids, hydrocarbons, and trace metals, yet the reasons behind these variations are at best poorly understood. Furthermore, relatively little is known about the processes which participate in the formation, maintenance, and dispersion of surface films on natural waters. Studied here is the distribution of organic carbon, fatty acids, hydrocarbons and selected heavy metals in the particulate phase of microlayer and subsurface water samples from Lake Michigan. Concentrations of organic matter and trace metals in the particulate phases of microlayers and subsurface waters are highest in the fluvial environment and decrease progressively toward the open lake. These patterns indicate that potamic sources are important to particulate organic carbon, particulate fatty-acid, particulate hydrocarbons, and particulate Ni, Cu, Fe, and Mn in Lake Michigan waters. Removal of particulate materials from microlayers and subsurface waters evidently occurs soon after these materials are carried to the lake by rivers. Settling of mineral particles appears to be the primary removal mechanism. Partial replacement of certain particulate organic components by aquatic sources occurs. Particulate fatty acids appear to be generated by neustonic and planktonic communities. Similar replacement of trace-metal components is not strongly indicated, even though atmospheric input is likely. Microlayer enrichment of particulate materials is greatest in open-lake environments where turbulent mixing is less effective than in coastal or fluvial areas. This observation also reflects the relatively high concentration of setting particles in fluvial and near-fluvial locations which acts to decrease enrichment factors. (See also W87-09164) (Lantz-PTT)
W87-09171

COPPER IN MARINE MICROLAYERS: ACCUMULATION, SPECIATION AND TRANSPORT,
Stanford Univ., CA. Dept. of Civil Engineering.
L. W. Lion, and J. O. Leckie.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 143-163, 8 fig, 3 tab, 72 ref. NSF Grant ENG-78-22085.

Descriptors: *Copper, *Marine environment, *Path of pollutants, *San Francisco Bay, *Air-water interfaces, Water surface profile, Adsorption, Model studies, Simulation analysis, Organic carbon, Bioaccumulation.

Literature information describing copper partitioning at the air-sea interface indicates organically bound and particulate forms of the metal are preferentially partitioned. The marine role of microbiota in the partitioning of copper is difficult to assess from the available data. Laboratory adsorption experiments with copper on well-characterized solids show that adsorption of the metal varies with the nature and concentration of complexing ligands (organic and inorganic) present in the system, with copper concentration, and as a function of solid surface-area concentration. Data from such experiments may be coupled with information describing copper complexation by dissolved ligands and used to calculate metal speciation in computer-simulated surface microlayer systems. The results of equilibrium chemical calculations indicate both complexation and adsorption to be important mechanisms which could act to control copper concentrations at the surface microlayer. Field data taken over a tidal cycle in a San Francisco Bay salt marsh confirm the partitioning of particulate copper. The data indicate little or not partitioning of dissolved organic carbon or dissolved copper. In the system sampled, enrichment of inorganic particulates appears to be the major control over copper enrichment at the air-sea interface. (See also W87-09164) (Lantz-PTT)
W87-09172

INPUT OF BIOLOGICALLY AVAILABLE PHOSPHORUS BY PRECIPITATION TO PRECAMBRIAN LAKES,
Ontario Ministry of the Environment, Rexdale. Limnology and Taxonomy Section.
P. J. Dillon, and R. A. Reid.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 183-198, 4 fig, 5 tab, 32 ref.

Descriptors: *Phosphorus, *Water pollution sources, *Limnology, *Precambrian lakes, *Canada, *Precipitation, Path of pollutants, Bioassay, Phosphates.

That precipitation is an important source of total phosphorus for Precambrian lakes is well-known. Studies of the mass budgets of a number of lakes in the Precambrian region of Canada have demonstrated that precipitation supplied 5-70% of the load or input of total phosphorus (TP). In general, available information indicates that a median value of 30-35% is realistic for the TP supplied by precipitation to Precambrian lakes that are not enriched by local point or diffuse sources. A kinetic bioassay technique is used here, to determine the biologically available phosphorus (BAP) content of precipitation samples collected in southern Ontario from 1977-1979. Because this technique uses o-PO4 as a standard against which availability to the biota of lake water is measured, the results provide an estimate of the magnitude of the immediately available component of the total phosphorus pool Also measured was the BAP content of the streams flowing into three lakes in this study area for which TP budget for the period 1976-1979 were measured. This report summarizes the results obtained for precipitation samples and discusses the relative importance of precipitation as a source of available phosphorus to oligotrophic Precambrian lakes. (See also W87-09164) (Lantz-PTT)
W87-09174

ATMOSPHERIC DEPOSITION OF NITROGEN AND PHOSPHORUS IN FLORIDA,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
C. D. Hendry, P. L. Brezonik, and E. S. Edgerton.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 199-215, 5 fig, 5 tab, 22 ref.

Descriptors: *Air pollution, *Atmospheric deposition, *Water pollution sources, *Nitrogen, *Phosphorus, *Florida, *Path of pollutants, Precipitation, Nitrates, Seasonal variation, Pollutant load, Fate of pollutants, Eutrophication.

Atmospheric nitrogen deposition from May 1978-May 1979 at 24 sites in Florida ranged from 0.32-1.13 g N/sq m/yr, with a state-wide mean (average of all the sites) of 0.75 g N/sq m/yr. Highest deposition rates were observed in predominantly agricultural areas, while coastal and forested regions had the lowest rates. Wet-only input was the dominant deposition mechanism for NH4(+)-N and NO3(-)-N, accounting for 81 and 68%, respectively, of the total (wet plus dry) deposition. Dryfall input was more important for organic N, representing 53% of the input of total organic nitrogen. Compared with data on the inorganic N content of Florida precipitation from 1955-1956, present results indicate a three-fold increase in the mean inorganic N concentration in wet-only precipitation. Phosphorus deposition averaged over all the sites was 50 mg P/sq m/yr, with highest deposition rates in predominantly agricultural regions and in areas of phosphate mining. Lowest deposition rates were observed in coastal and forested locations. Dryfall was the dominant mechanism for phosphorus deposition, account for 80% of the total (wet plus dry) input of phosphorus. Organic phosphorus was deposited primarily (85%) by dryfall and 73% of the soluble reactive phosphate occurred by dryfall. Inorganic phosphorus was the dominant form of phosphorus in both bulk and wet-only precipitation, comprising approximately 65% of the TP content. Concentrations of phosphorus were 50% higher in the convective summer rainstorms than in winter (frontal) storms. Examined in the context of critical nutrient loading rates for lake eutrophication, state-wide atmospheric deposition rates of nitrogen and phosphorus are below the loading rates associated with water quality problems, but deposition rates of both N and P at several agricultural locations did exceed 'permissible' levels. (See also W87-09164) (Lantz-PTT)
W87-09175

IMPORTANCE OF ATMOSPHERIC FLUXES TO THE NITROGEN BALANCE OF LAKES IN THE FLORIDA PENINSULA,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 2H.
W87-09176

ATMOSPHERIC DEPOSITION OF ACIDITY AND SULFUR IN FLORIDA,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
E. S. Edgerton, P. L. Brezonik, and C. D. Hendry.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 237-258, 6 fig, 5 tab, 35 ref. EPA Grant R-805560.

Descriptors: *Path of pollutants, *Water pollution sources, *Water pollution effects, *Acid rain, *Sulfur, *Florida, *Lake Okeechobee, Hydrogen ion concentration, Sulfuric acid, Sulfides, Precipitation.

Acid precipitation occurs across all of the panhandle and most of the peninsular region of Florida. Only coastal stations and those located south of Lake Okeechobee exhibit annual average pH values above 5.0. Sulfuric acid and calcium carbonate dominate the acid/base chemistry of Florida precipitation, and nitric acid and ammonium appear as minor components in a diffuse background. Naturally occurring alkalinity has been completely neutralized in many parts of the state, and future increases in acidity will depend directly on the increases in sulfur and nitrogen oxide emissions. Relative to anthropogenic emissions, estimated biogenic sulfur emissions are low, and they are improperly distributed to account for the observed patterns of acidity and sulfur deposition. State-wide anthropogenic emissions of SO2 are several times the state-wide sulfur deposition in bulk precipitation, and these emissions appear to control the distribution of acid rain in the state. Precipitation data from two mid-1950 studies suggest that several-fold increases in sulfur and hydrogen ion deposition in rainfall have occurred during the last 25 years. Such increases are limited mainly to areas where emissions of SO2 have increased during the same time span. The likelihood of further acidification of Florida precipitation in the coming years is enhanced by the national effort toward increased use of domestic coal supplies. Within the state of Florida, the electric power industry plans to increase the number of sites with coal-burning power plants from 9 to 22 within the next decade. As a consequence, combustion of coal is projected to increase from 7.4 to 26.8 million tons annually, during the same period. The influence of rising SO2 and NOx emissions on precipitation acidity and, in turn, on Florida's ecosystems bears close scrutiny in the coming years. (See also W87-09164) (Lantz-PTT)
W87-09177

TRACE METAL AND STRONG ACID COMPOSITION OF RAIN AND SNOW IN NORTHERN MINNESOTA,
Minnesota Univ., Minneapolis. Dept. of Civil and

Mining Engineering.
J. D. Thornton, S. J. Eisenreich, J. W. Munger, and E. Gorham.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 261-284, 8 fig, 5 tab, 27 ref.

Descriptors: *Path of pollutants, *Trace metals, *Acid rain, *Snow, *Minnesota, Precipitation, Spatial distribution, Soil contamination, Aluminum, Magnesium, Calcium, Manganese, Iron, Heavy metals, Zinc, Cadmium, Copper, Nickel, Lead, Chromium.

The concentrations of metals in precipitation in northern Minnesota show a definite spatial pattern. Concentrations are highest in the western regions where suspension of soil particles is likely to be the major source of components in precipitation. The concentration of major elements Al, Mg, Ca, Fe and Mn was lowest in the east where exposed soil surfaces are less. Noncrusted sources appear to influence the concentrations of the trace metals Zn, Cd, Cu, Ni, Cr, Pb and SO4 and NO3 in northeastern Minnesota. Wet deposition rates for trace metals in northeastern Minnesota were estimated s (in kg/ha/yr): Ca - 3.16; Al - 0.39; Fe - 0.25; Mn - 0.02; Pb - 0.049; Ni - 0.010; Zn - 0.65; Cd - 0.017; Cr - 0.0017; and Cu - 0.25. Snowmelt may contribute a significant portion of the total atmospheric deposition in northeastern Minnesota and cause stress on the aquatic environment during that period. (See also W87-09164) (Lantz-PTT)
W87-09178

TRANSPORT AND DRY DEPOSITION OF TRACE METALS OVER SOUTHERN LAKE MICHIGAN,
Governors State Univ., Park Forest South, IL. Environmental Management Program.
H. Sievering, M. Dave, D. A. Dolske, and P. McCoy.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 285-325, 5 fig, 13 tab, 36 ref. EPA Grant R005301012.

Descriptors: *Path of pollutants, *Air pollution, *Trace metals, *Lake Michigan, *Dry deposition, *Model studies, Climatology, Lead, Zinc, Iron, Heavy metals, Chemical analysis, Fate of pollutants.

Modeling estimates of atmospheric loading to Lake Michigan suggest a significant loading potential when compared to surface runoff. These estimation procedures are based upon: shore or near-shore wet deposition and meteorological data, extrapolation of wind-tunnel measurements of dry deposition to a water surface, and near-shore measurements of the chemical composition of atmospheric aerosols. However, the flux of aerosols to a water body is better approximated by the ambient concentration near that surface divided by the effective transfer resistance. Thus, ambient concentrations of aerosol constituents and concomitant surface resistances should be obtained over the Great Lakes as a function of climatology. This paper describes the variation in atmospheric concentrations and estimates the dry flux of several trace elements as a function of meso- and micrometeorology measured at the midlake region of southern Lake Michigan. Two to four sampling days with dry removal active in each of the months of May, June, August and September of 1977 constitute the data base considered. A comparison of minimum dry deposition loadings to estimates of precipitative loading and surface runoff inputs shows that the atmospheric inputs by dry loading are at least 40% of the total Pb input, 20% of the total Zn input and 15% of the total Fe input. Pb dry deposition inputs could be 75% or more of the total loading and Zn dry deposition inputs 50% or more, were the mean dry deposition estimates considered. Atmospheric loadings by dry deposition to the southern basin of Lake Michigan are clearly a significant part of the over-all inputs of Pb, Zn and probably Fe to the lake ecosystem. This is especially true because atmospheric loading contributes directly to the biologically active surface waters. Accurate quantification of the atmospheric input to the Great Lakes is an important continuing research endeavor. The identification of source types for Great Lakes atmospheric inputs will require a still closer scrutiny of existing data. Only then can management and control objectives to meet Great Lakes water quality goals be realized. (See also W87-09164) (Lantz-PTT)
W87-09179

ACID NEUTRALIZING CAPACITY OF FINE SOIL FRACTIONS,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
For primary bibliographic entry see Field 2G.
W87-09180

LICHENS AS MONITORS OF ATMOSPHERIC DEPOSITION,
Laurentian Univ., Sudbury (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W87-09181

USE OF BOG VEGETATION AS A MONITOR OF ATMOSPHERIC INPUT OF METALS,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 5C.
W87-09182

ATMOSPHERIC LEAD AND ZINC DEPOSITION INTO LAKES OF THE EASTERN UNITED STATES,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
A. O. Davis, and J. N. Galloway.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 401-408, 5 fig, 1 tab, 12 ref.

Descriptors: *Air pollution, *Lead, *Zinc, *Lakes, *Water pollution sources, Sedimentation rate, Chemical analysis, Path of pollutants, Lake sediments, Heavy metals.

Many investigators have used metals in lake sediments to demonstrate historic trends of environmental contamination. The object of this paper is to compare the metal burden in lake sediments from different regions of the Eastern United States by using a simple calculation which incorporates the sedimentation rate and metal concentration from different horizons in the sediment profile. Using this method of data analysis it is possible to compare, on a regional basis, the contribution of the principal sources of metal input; i.e., natural weathering products, atmospheric input and local anthropogenic activities within the watershed. The simple calculation presented in this paper allows comparison between sediment metal profiles of different shapes from lakes with different sedimentation rates, hence allowing comparison between lake sediments from different regions of the eastern United States. After distinguishing between bedrock (background) and anthropogenic inputs it is further possible to partition the anthropogenic component into atmospheric and intrawatershed contributions based on a comparison with other lakes in the same area. (See also W87-09164) (Lantz-PTT)
W87-09183

RATES OF ACCUMULATION OF HEAVY METALS IN PRE- AND POST-EUROPEAN SEDIMENTS IN NEW ENGLAND LAKES,
Maine Univ. at Orono. Dept. of Chemical Engineering.
S. A. Norton, C. T. Hess, and R. B. Davis.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 409-421, 5 fig, 3 tab, 7 ref. NSF Grant DEB 78-10641.

Descriptors: *Heavy metals, *Lake sediments, *Path of pollutants, Lead, Zinc, Chemical analysis, Fate of pollutants, Accumulation.

Three high-altitude oligotrophic lakes in New England with essentially undisturbed watersheds have been cored in the deepest part of each lake. Chemical analyses of the sediments reveal increases of Pb and Zn commencing about 1900 (slightly later to the northeast) and continuing to the present for Pb. Zn values decrease in near-surface sediments, apparently because of acid-leaching of the sediments. Ambient levels of Zn in lake water are postulated to increase significantly as a result of acidification and increased direct loading of Zn from precipitation. The rate of export of Zn from a lake/drainage basin system may increase by an order of magnitude because of acidification of soils/streams/lakes. Lead moves through the system in particulate form. Much of it apparently accumulates in the organic parts of the soil in the drainage basin. (See also W87-09164) (Lantz-PTT)
W87-09184

ATMOSPHERIC CONCENTRATIONS AND DEPOSITION OF POLYCHLORINATED BIPHENYLS TO LAKE SUPERIOR,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
S. J. Eisenreich, G. J. Hollod, and T. C. Johnson.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 425-444, 3 fig, 5 tab, 38 ref. EPA Grant R806084.

Descriptors: *Atmospheric deposition, *Model studies, *Air pollution, *Polychlorinated biphenyls, *Lake Superior, *Lake Michigan, *Path of pollutants, Organic compounds, Pesticides, Fish, Bioaccumulation, Pollutant load.

Organic contaminants (e.g., PCB, PAH, pesticides) enter the Great Lakes from atmospheric deposition, tributary inflows, municipal and industrial discharges and to a lesser extent by erosion. Output or losses of trace organics can occur through sedimentation, volatilization/bubble ejection across the water/air interface, biological and chemical degradation, and tributary outflow. The relative importance of specific sources and sinks depends on the physical and chemical properties of the trace organic, source strengths, basin characteristics, and biological stability. For the Great Lakes, atmospheric deposition has been implicated as the principal source of polychlorinated biphenyls (PCB) but environmental sinks have not been well studied. However, it is known that PCB bioconcentrate in the aquatic environment, and measured concentrations in some Lake Michigan fish and other Great Lakes fish exceed the USFDA criteria of 2 micrograms/gm. Based on previous data, the flux of atmospheric PCB across the air/water interface has been modeled. Assuming gas phase control, dry deposition of 4000 kg/yr PCB was calculated and combined with a wet deposition of 5000 kg/yr, yielding a total input of approximately 9000 kg/yr. Atmospheric deposition apparently accounts for greater than 80% of the PCB input to Lake Michigan. Atmospheric loading of PCB ought to be even more important to Lake Superior because of its large surface area (8.21 times 10 to the 10th power sq m), large surface-area-to-basin ratio, and lack of industrial/urban density, plus the fact that about two-thirds of its water budget is derived from precipitation. This paper reports the results of detailed sampling of PCB concentrations in air over Lake Superior and the estimation of atmospheric PCB deposition by both field measurement and model prediction. The potential impact of PCB deposition is discussed using an input-output model. (See also W87-09164) (Lantz-PTT)
W87-09185

INPUTS OF POLYCHLORINATED BIPHENYLS FROM THE ATMOSPHERE TO LAKES HURON AND MICHIGAN,
De Paul Univ., Chicago, IL.
T. J. Murphy, A. Schinsky, G. Paolucci, and C. P. Rzeszutko.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 445-458, 4 fig, 7 tab, 18 ref.

Descriptors: *Path of pollutants, *Atmospheric deposition, *Polychlorinated biphenyls, *Lake Huron, *Lake Michigan, *Water pollution sources,

Air pollution, Fish, Model studies, Sampling, Precipitation, Data.

PCB were recognized as environmental contaminants in the late 1960s and problems due to their presence surface at that time. In particular, their presence in Lake Michigan fish used for food was shown to be the cause for the decline in breeding success of ranch mink. Since PCB were assumed to be chemically similar to DDT in the environment, and the levels of DDT in Lake Michigan fish had responded reasonably rapidly to the ban on its use in the lake 1960s, it was thought that the levels of PCB in fish would also begin to decline after their sale for 'open' uses as halted in 1971 by their sole US manufacturer. However the data collected by the Great Lakes Fisheries Laboratory (GLFL) through 1976 show a much slower decline of PCB in fish in response to the ban than had occurred with DDT. In fact, there is a statistically significant decline in only one species, the chubs. Two approaches could be taken to determine whether PCB from the atmosphere were an important source of PCB to the lake: (1) to try and model the inputs, and (2) to try and determine the inputs by sampling. To devise a sampling program to measure PCB inputs from the atmosphere to Lakes Huron and Michigan is a difficult problem because of the many interactions between PCB in the air and water. Numerous studies have shown that PCB are present in the atmosphere as vapor and adsorbed on particulates. It has been found that the distribution between vapor and particulates is dependent on the vapor pressure of the particular PCB isomer. Results obtained with the event collectors indicate that the concentration of PCB in precipitation is quite variable, as result similar to that found by others for other constituents of precipitation. Because of an association with particulates, and the high concentration of particulates in the early part of a rain event, the amount of PCB scavenged by precipitation is more a function of the number of events than of the amount of precipitation. (See also W87-09164) (Lantz-PTT)
W87-09186

ATMOSPHERIC DEPOSITION OF PARTICULATE ORGANIC CARBON AND POLYAROMATIC HYDROCARBONS TO LAKE MICHIGAN,
Wisconsin Univ.-Madison. Water Chemistry Lab.
A. W. Andren, and J. W. Strand.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 459-479, 2 fig, 11 tab, 59 ref.

Descriptors: *Path of pollutants, *Atmospheric deposition, *Organic carbon, *Aromatic hydrocarbons, *Lake Michigan, *Water pollution sources, Pollutant identification, Seasonal variation, Particulate matter.

Data on total organic carbon (TOC) in atmospheric particulates, both total and size fractionated were collected on Lake Michigan during several cruises during spring, summer and fall from June 1975 to August 1977. The data were used to assess an annual atmospheric loading rate of TOC to Lake Michigan. Airborne concentrations of particulate-associated TOC over Lake Michigan ranged from 2.3 micrograms/cu m - 19.8 micrograms/cu m (avg 9.5). TOC comprises from 7.5%-50% of total airborne particulate matter. The data sets do not permit an evaluation of TOC concentrations as a function of meteorological parameters. A unimodal size function of atmospheric TOC was found in all instances, with the mass median diameter being in the submicron range. Calculations were made for four different wind speed regimes. Total particulate TOC flux via dry deposition to Lake Michigan was found to be 3600 tons/yr. Wet deposition was calculated to be about 150,000 tons/yr, giving a wet-to-dry input ratio of 40:1. Twelve polyaromatic hydrocarbons (PAH) in air over Lake Michigan were identified, ranging in concentrations from 0.1 to 4.2 nanograms/cu m. PAH produced by combustion of coal and gasoline is believed to account for the source of these compounds. The role of photolysis as a route for PAH degradation between generation and deposition to the lake is presently unknown. PAH deposition estimates to Lake Michigan are somewhat uncertain because of limited data sets. However, a total deposition of 40 tons/yr, with a wet-to-dry ratio of 9:1 does not seem unreasonable. The 12 PAH identified in this study comprise about 0.1% of the total dry particulate TOC deposition, while these compounds only comprise about 0.02% of the total TOC deposition in the lake. These figures will be modified in the future as the role of vapor phase transfer becomes clearer. (See also W87-09164) (Lantz-PTT)
W87-09187

AERIAL DEPOSITION OF ORGANOCHLORINES IN URBAN AND COASTAL SOUTH CAROLINA,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
T. F. Bidleman, E. J. Christensen, and H. W. Harder.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 481-508, 13 fig, 6 tab, 50 ref. NSF Grant OCE-76-15629 and NIH Grant 5 SO7 RR07160.

Descriptors: *Path of pollutants, *Air pollution, *Organochlorine compounds, *Atmospheric deposition, *South Carolina, *Water pollution sources, Pesticides, Polychlorinated biphenyls, Dieldrin, Particulate matter, Insecticides, Pollutant load.

Aerial transport is responsible for the global dispersion of many natural and anthropogenic substances, including organochlorine (OC) pesticides and polychlorinated biphenyls (PCB). The first reports of long-range OC pesticides transport over the ocean came in 1968-1972, when dieldrin and DDT residues were found on dust carried across the Atlantic Ocean by the northeast trade winds. More recently, PCB and several OC pesticides have been measured in ocean air (primarily in the vapor phase) over the northwest Atlantic, the Irish Sea, and the Gulf of Mexico. PCB and DDT residues have been found in such remote areas as the Antarctic snowfields, the snowdome of Mount Olympus, Washington, and in aerial fallout in Iceland. Recent quantitative estimates show that atmospheric input by rainfall or particle deposition contributes significantly to the pollutant budgets of natural waters. For several reasons, high-molecular-weight OC are excellent compounds with which to study the atmospheric removal of trace organics. Reported vapor pressures for PCB and chlorinated insecticides vary over three orders of magnitude and are in the same range as vapor pressures of other pollutants and naturally occurring organic compounds. OC are stable, so breakdown during sampling and analysis is minimal. Finally, because of their sensitivity to electron capture detection, OC can be selectively measured in air even at the subnanogram per cubic meter levels present over the open ocean. In 1976, a study was begun of OC atmosphere-removal proceses in urban and coastal South Carolina to determine the influence of OC physical properties on washout and dry deposition rates, and the importance of aerial input of OC to South Carolina coastal waters. The methods, study locations, and results of this study are presented. (See also W87-09164) (Lantz-PTT)
W87-09188

ADSORPTION OF INORGANIC POLLUTANTS IN AQUATIC SYSTEMS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
D. A. Dzombak, and F. M. M. Morel.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 113, No. 4, p 430-475, April 1987. 21 fig, 1 tab, 116 ref, 3 append.

Descriptors: *Adsorption, *Inorganic compounds, *Path of pollutants, *Water pollution, *Trace metals, *Model studies, Ions, Chemical reactions, Mass transfer, Sorption, Particulate matter, Mathematical equations, Electrical properties, Oxides.

The concepts and models used to describe and quantify adsorption of trace organic pollutants in aquatic systems are described. In contrast to the nonspecific sorption mechanism proposed for hydrophobic organic compounds, adsorption of inorganic solutes is viewed as a site-specific process in which ions bind (chemically) at functional groups on particle surfaces. This conceptual model is supported by the finding that adsorption of ions on model adsorbents with relatively well-defined surface groups (e.g., hydrous metal oxides) can be described by mass law equations, a fact which forms the basis for all surface complexation models. Surface complexation reactions are distinguished from reactions among monomeric solutes in that the total energy of interaction includes long-range electrostatic effects that vary with surface charge. Electrostatic effects are accounted for by applying a coulombic correction factor (activity coefficient) to intrinsic surface complexation constants. Formulations for the coulombic correction term differ among the various surface complexation models. These models can be used to predict inorganic ion adsorption on hydrous oxides for changing solution conditions on the basis of fewer data than needed with a purely empirical approach. (Author's abstract)
W87-09194

IMPACT OF AGRICULTURE ON SURFACE WATER IN IRELAND: PART I. GENERAL,
Foras Forbartha, Teoranta, Dublin (Ireland). Water Resources Div.
P. F. Toner.
Environmental Geology and Water Sciences EGWSEI, Vol. 9, No. 1, p 3-10, 1986. 1 fig, 4 tab, 19 ref.

Descriptors: *Farm wastes, *Water pollution sources, *Ireland, *Surface water, *Eutrophication, Trophic level, Contamination, Nitrates, Lakes, Pesticides, Fertilizers, Agricultural chemicals, Livestock, Water quality, Water pollution effects, Agricultural runoff, Feeds, Silage, Runoff, Agriculture.

The impact of agriculture on surface waters in Ireland is reviewed. Total agricultural waste discharge to Ireland is 10,000 tons BOD/yr, the bulk of which is likely to enter freshwaters and is of the same order of magnitude as the combined load discharged to such waters from domestic and industrial sources. The importance of agricultural waste is increasing in relative importance because of improved domestic and industrial wastewater treatment and upward trends in the intensive rearing of livestock and use of silage as animal fodder. The increased amounts of liquid wastes requiring disposal on land may cause further pollution. The disposal of manure slurries from intensive rearing and silage operations are the main agricultural operations implicated in pollution incidents. It is suggested that, in the long term, the main effect of agriculture on Irish surface waters will be eutrophication. (See also W87-092000) (Author's abstract)
W87-09199

HEAVY METALS DISTRIBUTION IN THE SEDIMENTS OF GANGES AND BRAHMAPUTRA RIVERS,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
V. Subramanian, R. Van Grieken, and L. Van't Dack.
Environmental Geology and Water Sciences EGWSEI, Vol. 9, No. 2, p 93-103, 1987. 7 fig, 8 tab, 17 ref. Belgium Ministry of Science Policy Contract 80-85/10.

Descriptors: *Heavy metals, *Path of pollutants, *Bed load, *Sediments, *Ganges River, *Brahmaputra River, *Water pollution sources, *Solute transport, Suspended sediments, Iron, Manganese, Nickel, Chromium, Copper, Zinc, Fluorescence, X-ray fluorescence, Distribution, Temporal distribution, Spatial distribution, Flow.

Bed sediments were collected from the entire Ganges basin and some parts of the Brahmaputra, and selected stations were sampled for suspended sediments as well. Samples were analyzed for a number of heavy metals (Fe, Mn, Ni, Cr, Cu, and Zn) by thin-film energy dispersive X-ray fluorescence. Pronounced temporal and spatial variations were found in the heavy metals distributions. Sus-

pended sediments are 5-10 times richer than the bed sediments. None of the tributaries contributes significant heavy metal load, but very high levels due to the distribution from the drainage network are observed around urban areas in Yamuna (tributary of Ganges). Compared to the Brahmaputra, the distribution and fractionation of heavy metals in the Ganges sediments are more erratic and highly variable. All the metals show high correlation among themselves. Given the high flux of suspended sediments from the Himalayan rivers (nearly 20% of the global flux), the worldwide budget for heavy metal transport may need to be revised. (Author's abstract)
W87-09204

NONPOINT AGRICULTURAL POLLUTION: PESTICIDE CONTAMINATION OF GROUNDWATER SUPPLIES,
Rhode Island Univ., Kingston. Dept. of Resource Economics.
G. D. Anderson, J. J. Opaluch, and W. M. Sullivan.
American Journal of Agricultural Economics, Vol. 67, No. 5, p 1238-1243, 1985. 1 tab, 9 ref.

Descriptors: *Nonpoint pollution sources, *Farm wastes, *Groundwater pollution, *Groundwater management, *Contamination,, *Pesticides, *Aldicarb, *Policy making, *Water pollution sources, Estimating equations, Wastes, Groundwater, Pollution, Water quality standards, Rhode Island, Potatoes, Mathematical equations, Mathematical analysis, Mathematical models, Dynamics, Administrative decisions.

A general model is described for determining on-site standards for pesticide applications that satisfy drinking water standards for chemical contamination. A contamination function was then estimated that links field applications to groundwater concentrations off aldicarb. This relationship can be used to identify feasible pesticide application rates, and may provide information on how to sample wells for contamination and help to understand the movement of other chemicals into groundwater. However, the contamination function is specific to Rhode Island soils and aquifers and to solubility characteristics of aldicarb. Therefore, it may be necessary to set on-site standards on a regional basis, which requires the development of region-specific data. The need for data and field testing of pesticides is emphasized in order to protect our valuable groundwater resources without abandoning economic activities at the surface. (Author's abstract)
W87-09213

RELATIONSHIP BETWEEN WATER-SYSTEM SIZE AND 222RN CONCENTRATION IN NORTH CAROLINA PUBLIC WATER SUPPLIES,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5F.
W87-09218

PUBLIC HEALTH SIGNIFICANCE OF INDUSTRIAL POLLUTION IN ZARIA, NIGERIA,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Veterinary Public Health and Preventive Medicine.
A. O. Oganga, and D. Abijoroh.
Journal of the Royal Society of Health, Vol. 106, No. 6, p 211-215, December 1985. 3 tab, 8 ref, 2 append.

Descriptors: *Public health, *Epidemiology, *Water pollution sources, *Water pollution effects, Air pollution effects, Pollution load.

This study applies to Nigeria a World Health Organization procedure for making a rapid assessment of the amount of air, water, and land pollution in a given region or country. Information regarding the nature and quantity of raw materials used in industry, government agencies, and other institutions in Zaria, the type of waste products generated, and the methods of their disposal is combined with medical records from the Ahmadu Bello University Teaching Hospital about diseases that may be associated with environmental pollution for 1981-1982. Industries included tarpaulin making, corrugated cardboard making, cigarette making, leather tanning, foam making, and slaughter houses. Diseases which could be associated with environmental pollution, in descending order, were malaria, gastroenteritis, pneumonia, thyphoid, dysentry, asthma, schistosomiasis, salmonellosis, infectious hepatitus, pulmonary emphysema, poliomyelitis paratyphoid, and trichomonasis. Only 34% of Nigerian communities had access to potable water. Improper management of solid waste was a major problem. (McFarlane-PTT)
W87-09226

PESTICIDES IN FOG,
Dept. of Agriculture, Beltsville, MD. Soil Nitrogen and Environmental Chemistry Lab.
D. E. Glotfelty, J. N. Seiber, and L. A. Liljedahl.
Nature NATUAS, Vol. 325, No. 6105, p 602-605, February 1987. 1 fig, 1 tab, 23 ref.

Descriptors: *Path of pollutants, *Pesticides, *Fog, *Acid rain, Acid water, Organic acids, Organic compounds, Precipitation.

The discovery of the very acidic nature of fog and clouds has created much interest in sampling, analyzing, and elucidating the chemistry of fog, principally because an understanding of the chemical transformations leading to acid fog may provide important clues to the origin of acid rain. Recently, the knowledge of the chemistry of fog has expanded to include carbonyl compounds, volatile organic acids, and alkyl sulphonates. We have discovered that a variety of pesticides and their toxic alteration products are present in fog, and that they occasionally reach high concentrations relative to reported rainwater concentrations. In our experiments, we were able to measure the air-water distribution coefficients of pesticides between the liquid fog and the interstitial gas phase. These measurements reveal that some chemicals are enriched several thousandfold in the suspended liquid fog droplets compared to equilibrium distributions expected from Henry's Law coefficients for pure aqueous solutions. (Author's abstract)
W87-09229

DISPOSITION OF LOW AND HIGH ENVIRONMENTAL CONCENTRATIONS OF PCBS IN SNAPPING TURTLE TISSUES,
State Univ. of New York at Albany. Dept. of Chemistry.
A. M. Bryan, P. G. Olafsson, and W. B. Stone.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 6, p 1000-1005, June 1987. 2 tab, 21 ref.

Descriptors: *Polychlorinated biphenyls, *Snapping turtles, *Tissue analysis, *Path of pollutants, *Bioindicators, *Bioaccumulation, Monitoring, Wildlife, Habitats, Population exposure, Enzymes.

Organisms living in water are sensitive to changing environmental conditions and may, due to the general equilibrium between the biotic community and its environment, be utilized to monitor toxics in aqueous ecosystems. Snapping turtles, as a result of their ability to store high concentrations of PCBs in their fat, provide an excellent screen for the detection of trace toxic substances in water. Wildlife monitoring focusses on the pollution of the wildlife itself, but the use of selected specimens may also be employed to monitor the pollution of the habitat. The data obtained in this study markedly reflect the difference in pollution levels of the sites from which the turtles were obtained. Despite the wide difference in degree of exposure to PCBs, their accumulation within the reptile is not random but rather shows an ordered preference for specific locations, eg. fat, testes and brain. The higher concentrations found in the latter regions reflect the lipoprotein solubility of PCBs. In the remaining tissues the relative order is probably due to the corresponding concentrations of the appropriate enzymes required for metabolism of these substances. (Alexander-PTT)
W87-09234

CHARACTERIZATION OF THE PAC PROFILE IN SETTLING PARTICULATES FROM THE URBAN WATERS OF STOCKHOLM,
Dept. of Zoology, Univ. of Stockholm, S-106 91 Stockholm, Sweden.
D. Broman, A. Colmsjo, and C. Naf.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 6, p 1020-1028, June 1987. 1 fig, 1 tab, 15 ref.

Descriptors: *Polynuclear aromatic compounds, *Urban areas, *Particulate matter, *Water pollution sources, Fuel, Combustion, Nonpoint pollution sources.

Polynuclear aromatic compounds (PAC) in urban areas emanate primarily from incomplete combustion of fossil fuels and fossil fuel products. A vast number of 'nonpoint sources' are accountable for the contribution to the aquatic environment such as house heating, power plants and municipal incinerators, automobile exhaust emissions and rub-off substances from the traffic such as asphalts and rubber tires. These PACs reach the water through municipal sewage effluents, urban runoff and direct deposition of airborne particulates. Direct spills of different kinds e.g., fuel oils, bunker oils, crankcase oils and greases, also contribute to the PAC pollution in water. PAC mixtures with a high degree of methylated polynuclear aromatic compounds have recently been demonstrated to be present in, for example, crude oil and asphalts, but high levels may also be generated by inefficient combustion conditions, as in the case of smouldering of organic fuels. According to Sprostol et al. the distribution of dibenzothiophenes, parent compounds versus the methylated, found in the particulate material points to an impact which originates from unburned fossil fuel products, in contrast to this the distribution (parent versus the methylated) of the fluoranthenes/pyrenes and relative amounts of the sums of phenanthrenes/anthracenes, dibenzothiophenes, fluoranthenes/pyrenes indicates a combustion origin. Finally, the fossil fuel pollution index (FFPI) points to a petroleum impact of approximately 14 percent (naphthalenes were not quantified and are therefore not included in the formula). All this illustrates the difficulty in attempting to evaluate the importance of different PAC sources in a 'nonpoint source' pollution impacted water-area such as this. (Alexander-PTT)
W87-09237

BIOACCUMULATION POTENTIAL OF HETEROTROPHIC BACTERIA FOR LEAD, SELENIUM, AND ARSENIC,
Dept. of Pharmacy, Univ. of Port Elizabeth, P.O. Box 1600, Port Elizabeth 6000, South Africa.
G. A. Thompson, and R. J. Watling.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 6, p 1049-1054, June 1987. 3 tab, 11 ref.

Descriptors: *Marine sediments, *Bioaccumulation, *Heterotrophic bacteria, *Heavy metals, *Path of pollutants, Lead, Selenium, Arsenic, Cultures, Bacteria.

Metal compounds are essential for the development and survival of all life forms and bacteria play a major role in the geochemical and biological recycling of these compounds. In the marine environment, one of the most significant metal-microbe interactions is the uptake of metal compounds by bacteria. Such metal-bacterial bioaccumulations can be beneficial, as well as detrimental, to the ecology as a whole or to individual members of the biota. The metal compounds used in this study (lead, selenium, arsenic) were selected on the basis that they are frequently encountered in industrial and domestic wastes and agricultural run-off respectively. The bacteria were selected to include possible autochthonous environmental isolates as well as enteric strains since these often co-exist in marine sediments. Whilst this study used pure cultures for measuring the bioaccumulation potential of selected bacterial species, in situ experiments are also needed in order to fully understand the environmental impact of such interactions. Nevertheless microcosm experiments are valuable in determining the interactions of a wide range of metal compounds and bacterial species. The results can

then be applied to more detailed studies including the metal leaching potential of bacteria as well as the environmental effects of bioaccumulated metal compounds. (Alexander-PTT)
W87-09240

TOXICITY AND BIOACCUMULATION OF CADMIUM IN EXPERIMENTAL CULTURES OF DUCKWEED, LEMNA POLYRRHIZA L.,
Dept. of Botany, UER Pharmacy of Rouen, 76800 Saint Etienne du Rouvray, France.
For primary bibliographic entry see Field 5C.
W87-09241

ZINC, IRON, MANGANESE, AND MAGNESIUM ACCUMULATION IN CRAYFISH POPULATIONS NEAR COPPER - NICKEL SMELTERS AT SUDBURY, ONTARIO, CANADA,
Dept. of Biology, Laurentian Univ., Sudbury, Ontario P3E 2C6, Canada.
For primary bibliographic entry see Field 5C.
W87-09243

ZINC, COPPER AND NICKEL CONCENTRATIONS IN SOIL EXTRACTS AND CROPS GROWN ON FOUR SOILS TREATED WITH METAL-LOADED SEWAGE SLUDGES,
Rothamsted Experimental Station, Harpenden, Herts, AL5 2JQ, Great Britain.
J. R. Sanders, S. P. McGrath, and T. M. Adams.
Environmental Pollution, Vol. 44, No. 3, p 193-210, 1987. 2 fig, 9 tab, 16 ref.

Descriptors: *Land application, *Sludge disposal, *Path of pollutants, *Bioaccumulation, *Heavy metals, Zinc, Copper, Nickel, Soil types, Food crops, Soil properties.

Sludges containing high concentrations of zinc, copper or nickel and an uncontaminated sludge were added to two sandy loams (pH 6.5 and 7.1), a heavy clay (pH 6.3) and a calcareous clay (pH 7.8) to give ten sludge treatments for each soil. The mixtures were incubated fallow, cropped continuously with clover, or cropped with barley and red beet in rotation for 21 months. The quantity of added metal either in the soil solution or extracted by 0.1M CaCl2 depended on the metal loading, pH and soil cation exchange capacity, and changed with time after mixing soils and sludges. Crop metal concentrations, and the occurrence of metal-induced yield reductions, also depended on soil properties as well as metal loading. The best chemical extractant for predicting plant metal concentrations was 0.1M CaCl2. (Author's abstract)
W87-09244

RESPONSE OF LAKE SEDIMENTS TO CHANGES IN TRACE METAL EMISSION FROM THE SMELTERS AT SUDBURY, ONTARIO,
Canada Centre for Inland Waters, Burlington (Ontario).
J. O. Nriagu, and S. S. Rao.
Environmental Pollution, Vol. 44, No. 3, p 211-218, 1987. 2 fig, 19 ref.

Descriptors: *Lake sediments, *Water pollution sources, *Path of pollutants, *Emissions, *Smelters, *Metals, Ontario, Lakes, Acidification.

Historical records preserved in sediments show that near Sudbury, Ontario lakes are extremely sensitive to metal emissions from the smelters in the Sudbury basin. From the observed quick response, a strong capacity for rapid recovery (de-acidification) of acid-stressed lakes in the area is deduced. The study thus emphasises the need for curtailing the emissions of acidic and acidifying substances as a critical step in reducing lake acidification as well as in rehabilitating many of the afflicted lakes. (Author's abstract)
W87-09245

ATTEMPT TO MEASURE THE FLOW OF CHLORINATED HYDROCARBONS, SUCH AS PCBS, FROM WATER TO AIR IN THE FIELD,
Inst. of Limnology, Univ. of Lund, Box 65, S-22100 Lund, Sweden.
For primary bibliographic entry see Field 7B.
W87-09246

KINETIC MODELS FOR PREDICTING BIOACCUMULATION OF POLLUTANTS IN ECOSYSTEMS,
Dept. of Physiology and Biochemistry, The University, PO Box 228, Whiteknights, Reading RG62AJ, Great Britain.
C. H. Walker.
Environmental Pollution, Vol. 44, No. 3, p 227-240, 1987. 4 fig, 25 ref.

Descriptors: *Kinetic models, *Model studies, *Bioaccumulation, *Path of pollutants, *Bioaccumulation, *Metabolism, Prediction, Pollutants, Partition coefficients, Kinetics.

Steady state kinetic models, which may be useful for prediction from simple data, of the bioaccumulation of lipohilic pollutants in ecosystems are discussed. For some aquatic species, such as Mytilus edulis, bioconcentration factors (BCFs) are closely related to water solubilities, and octanol:water partition coefficients (K sub ow). In other cases, more complex models are necessary to take account of metabolism and/or uptake from food. Somewhat different considerations apply in the estimation of bioaccumulation factors (BFs) for terrestrial organisms that cannot excrete lipophilic compounds by diffusion into ambient water. The relationship between half-lives and BFs is discussed. Metabolism is necessary for the effective elimination of lipophilic pollutants by terrestrial animals, and a model is proposed for the prediction of BFs from kinetic data obtained from in vitro metabolism studies. If such a model can be successfully developed it will make possible the prediction of bioaccumulation of pollutants by a wide range of species which cannot be studied by present methods. (Author's abstract)
W87-09247

MODELLING OF BOD-DO DYNAMICS IN AN ICE-COVERED RIVER IN NORTHERN CHINA,
Research Inst. of Environmental Science, Peking Normal Univ., Peking, China.
H. Ranjie, and L. Huimin.
Water Research WATRAG, Vol. 21, No. 3, p 247-251, March 1987. 7 fig, 3 tab, 8 ref.

Descriptors: *Model studies, *Biological oxygen demand, *Dissolved oxygen, *Tu Men River, China, Sedimentation, Ice, Rivers, China, Water quality.

BOD-DO dynamics in a river in northern China during a period of sub-zero temperatures have been investigated and a mathematical model which describes the dynamics has been proposed. The model parameters: deoxygenation rate k sub 1, reaeration rate k sub 2, BOD sedimentation - resuspension rate k sub 3 were determined by a parameter estimation method using the field data collected on Tu Men River. Validation of the model shows that BOD-DO dynamics in the river during that season are well described by the model. The model offers a tool for understanding the natural purification process in the rivers in northern China under ice-cover conditions and also for control of water quality in those rivers. (Author's abstract)
W87-09262

CORRELATION OF SOME ORGANIC POLLUTION FACTORS IN WATER SYSTEMS IN NORTHERN GREECE,
Laboratories of Analytical Chemistry and Environmental Pollution Control, Univ. of Thessaloniki, Greece.
A. Voulgaropoulos, K. Fytianos, A. Apostolopoulou, and X. Gounaridou.
Water Research WATRAG, Vol. 21, No. 3, p 253-256, March 1987. 3 fig, 2 tab, 4 ref.

Descriptors: *Water analysis, *Organic compounds, *Water pollution, *Greece, Lakes, Rivers.

The degree of organic pollution in natural waters of northern Greece has been evaluated through measurement of TOC, DO, fluorescence, absorbance and complexing capacity. Additionally certain other parameters were measured like temperature, conductance, hardness, alkalinity and total iron content to get a better idea of the extent of pollution. The results showed that Lake Agios Vasilios was the most heavily polluted. On the other hand the River Loudias has greater organic charge than the River Axios. (Author's abstract)
W87-09264

EFFECT OF BEAVER PONDS ON THE NON-POINT SOURCE WATER QUALITY OF A STREAM IN SOUTHWESTERN WYOMING,
Wyoming Univ., Laramie. Dept. of Zoology and Physiology.
For primary bibliographic entry see Field 2H.
W87-09265

INVESTIGATION INTO THE RETENTION OF 65ZN ABSORBED BY THE TROPHIC PATHWAY IN CYPRINUS CARPIO L. INFLUENCE OF THE INGESTION FREQUENCY AND THE RADIOZINC CONTENT OF FOOD (ETUDE DE LA RETENTION DU 65ZN ABSORBE PAR VOIE TROPHIQUE CHEZ CYPRINUS CARPIO L. INFLUENCE DU RYTHME D'INGESTION ET DE LA TENEUR EN RADIOZINC DE LA NOURRITURE),
Lab. de Radioecologie des Eaux continentales, CEA.SERE.CEN CADARACHE, 13108 Saint Paul lez Durance Cedex, France.
J. P. Baudin.
Water Research WATRAG, Vol. 21, No. 3, p 285-294, March 1987. 4 fig, 6 tab, 38 ref.

Descriptors: *Path of pollutants, *Food chains, *Zinc isotopes, *Bioaccumulation, *Radionuclides, Metabolism, Carp, Diets, Nutrients, Feces, Fish.

Published results on the relative contribution of food and water in the accumulation of 65Zn by freshwater fish are contradictory and it is observed that the retention rate of radiozinc absorbed from food varies over a wide range (from 5 to 70%) depending on the authors. The present paper aims to highlight the variability of the retention rate of the radionuclide absorbed from contaminated food. Two experiments were carried out using the soft tissue of previously contaminated lymnaea as food. The first experiment was conducted over a 9 week period on three groups of carp, each receiving food of identical composition, the only difference concerning the splitting up of the weekly food intake. The second experiment was carried out over a 40 day period on a group of 15 carps which received 26 daily meals. The feces are a very important pathway of the radionuclide excretion. This fact agrees with high radioactivity levels measured in the digestive tract of fish contaminated from water or placed in decontamination for several days or weeks. (Alexander-PTT)
W87-09268

BIODEGRADABILITY OF PARA-DICHLOROBENZENE AND ITS BEHAVIOUR IN MODEL ACTIVATED SLUDGE PLANTS,
Unilever Research, Port Sunlight Lab., Quarry Road East, Bebington, Wirral, Merseyside L63 3JW, U.K.
For primary bibliographic entry see Field 5D.
W87-09269

DEGRADATION OF ANILINE AND CHLOROANILINES BY SUNLIGHT AND MICROBES IN ESTUARINE WATER,
Georgia Univ., Athens. Dept. of Microbiology.
H.-M. Hwang, R. E. Hodson, and R. F. Lee.
Water Research WATRAG, Vol. 21, No. 3, p 309-316, March 1987. 3 fig, 3 tab, 43 ref. NOAA Grant NA84AA-D-00072.

Descriptors: *Estuaries, *Fate of pollutants, *Biodegradation, *Anilines, *Solar radiation, *Photolysis, Incubation, Bacteria, Microbiological studies, Algae, Mineralization.

The relative importance in estuarine water of photolysis and microbial degradation on aniline and a

series of chloroanilines (p-chloroaniline, 2,4-dichloroaniline, and 2,4,5-trichloroaniline) was determined. Photolysis was important for all compounds with photo-transformation half-lives in surface estuarine water ranging from 2 to 125 h. Photolysis rates were lower in estuarine water relative to distilled water, which we speculate was due to quenching of excited states by humics. There was no microbial degradation of chloroanilines during short-term incubations (up to 3 days). The half-lives of aniline in estuarine water was 27 and 173 h in the light and dark (microbial), respectively. Photolysis and microbial degradation rate constants decreased in winter. The winter decrease in photolysis rates correlated to a decrease in surface irradiance while the microbial degradation decrease correlated to the temperature decrease. There was rapid microbial degradation of the chloroanilines and aniline photoproducts. The mineralization of photoproducts of chloroanilines was carried out by bacteria, while microbes larger than 3 micron, e.g., algae, were responsible for the bioaccumulation of the compounds. (Author's abstract)
W87-09271

KINETICS AND MECHANISMS OF HYPOCHLORITE OXIDATION OF ALPHA-AMINO ACIDS AT THE TIME OF WATER DISINFECTION (CINETIQUES ET MECHANISMES DE L'ACTION OXYDATIVE DE L'HYPOCHLORITE SUR LES ACIDES ALPHA-AMINES LORS DE LA DESINFECTION DES EAUX),
Lab. de genie sanitaire, Ecole Nationale de la Sante Publique (ENSP), Avenue du Professeur Leon Bernard, 35043 Rennes Cedex, France.
For primary bibliographic entry see Field 5F.
W87-09274

TRIHALOMETHANE FORMATION IN WHIRLPOOL SPAS,
Environmental Health Directorate, Health and Welfare Canada, Environmental Health Centre, Tunney's Pasture, Ottawa, Ontario K1A 0l2.
F. M. Benoit, and R. Jackson.
Water Research WATRAG, Vol. 21, No. 3, p 353-357, March 1987. 2 tab, 12 ref.

Descriptors: *Water pollution sources, *Disinfection, *Water treatment, *Trihalomethanes, *Whirlpool spas, *Recreation, Halogenated compounds, Air pollution, Swimming pools.

In a survey of 25 whirlpool spas using halogen disinfectants, the only organohalide contaminant observed in the water and in the air at concentrations in excess of 1 microgram(ug)/L (water) and 1 ug/cu m (air) was the trihalomethane corresponding to the disinfectant used. The levels of trihalomethane observed in the water in thermal spas were comparable to levels reported for swimming pools. We conclude that the heat, agitation and aeration of the spas do not produce higher residual levels of trihalomethanes in the water and do not promote the formation of novel volatile organohalides. The concentration of trihalomethane in the water appeared to be related to the combination of high total dissolved solids and high disinfectant levels. The trihalomethane levels in the air though dependent on the concentration of trihalomethane in the water were modified by the variety of room sizes, ventilation rates, water surface areas and aeration rates associated with each individual spa. (Author's abstract)
W87-09276

HYDROLOGICAL AND CHEMICAL FACTORS CONTROLLING THE CONCENTRATIONS OF FE, CU, ZN AND AS IN A RIVER SYSTEM CONTAMINATED BY ACID MINE DRAINAGE,
Applied Geochemistry Research Group, Royal School of Mines, Imperial Coll., London SW7.
C. A. Johnson, and I. Thornton.
Water Research WATRAG, Vol. 21, No. 3, p 359-365, March 1987. 8 fig, 1 tab, 23 ref.

Descriptors: *Estuaries, *Path of pollutants, *Heavy metals, *Mine drainage, *Carnon River, Seasonal variation, Trace elements, Iron, Zinc, Copper, Arsenic, Infiltration, Salinity.

The seasonal variations in the trace element concentrations and flow rates in the Carnon River system, south west England have been investigated on a monthly basis for a period of 1 yr. Approximately 85% of Fe, Zn and As, and 45% of Cu originate from mine waters. A strong seasonal dependence of the flux of trace elements in the natural and mine waters is observed. There appears to be a direct correlation between trace element concentrations and the proportion of infiltrated surface drainage in mine waters. Rises in these concentrations in the Carnon River due to increased fluxes from mine waters in winter months are offset by higher flow rates in surface discharge. Iron is transported predominantly in the particulate phase in Carnon River waters and virtually all dissolved Fe (<0.45 micron) precipitates in estuarine waters. Dissolved concentrations of Cu, Zn and As appear to be regulated by sorptive processes particularly with Fe oxyhydroxides in both fresh and saline waters. (Author's abstract)
W87-09277

FUNDAMENTALS OF AQUATIC TOXICOLOGY: METHODS AND APPLICATIONS.
FMC Corp., Princeton, NJ.
For primary bibliographic entry see Field 5C.
W87-09280

PESTICIDES,
Colorado State Univ., Fort Collins. Dept. of Fishery and Wildlife Biology.
For primary bibliographic entry see Field 5C.
W87-09291

POLYCYCLIC AROMATIC HYDROCARBONS,
Battelle New England Marine Research Lab., Duxbury, MA. William F. Clapp Labs.
For primary bibliographic entry see Field 5C.
W87-09293

ANALYTICAL CHEMISTRY,
Northeastern Univ., Boston, MA. Dept. of Chemistry.
T. R. Gilbert, and J. P. Kakareka.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 475-494, 5 fig, 1 tab, 44 ref.

Descriptors: *Toxicity, *Water analysis, *Chemical analysis, *Pollutant identification, Fate of pollutants, Monitoring, Trace metals, Atomic absorption spectrophotometry, Voltammetry, Cadmium, Lead, Plasma emission spectrometry, Chromatography, Qualitative analysis, Quantitative analysis, Gas chromatography.

Before toxicity testing begins, analytical protocols for monitoring toxicant concentrations must be thoroughly evaluated and established. Samples should be taken and prepared in ways designed to monimize contamination or loss of analyte through adsorption, precipitation, or volatilization. Toxic trace metals can be determined in liquid samples at or even below the level of micrograms per liter. Graphite furnace atomic absorption spectrophotometry may be used to measure most toxic trace metals at such low levels. Cadmium and lead can also be measured by differential pulse anodic stripping voltammetry. This technique is well suited for analyses of marine samples since the matrix elements provide a natural electrolyte that does not react electrochemically at the sensing electrode. However, the technique is limited to elements that can be reduced and reoxidized in a potential range limited by reduction of the hydrogen ion and oxidation of the mercury-sensing electrode. If simultaneous multielement detection is more important than high sensitivity, plasma emission spectrometry may be the technique of choice. Analytical sensitivity can be improved by preconcentration techniques such as solvent extraction or ion exchange chromatography. Trace organic toxicants can be determined in various samples in the range of parts per billion to parts per million. These low values usually necessitate extraction and concentration before quantification. The principal methods for qualitative and quantitative analyses of organic toxicants are gas chromatography and liquid chromatography. The choice between these methods for quantification of the analyte depends on the sample matrix, physical and chemical properties of the analyte, and sensitivity required. Gas chromatography requires extraction, concentration, and, if necessary, derivatization of the analyte to a volatile compound. Generally, gas chromatography with one of a wide variety of specific detectors provides greater sensitivity than liquid chromatography for substances present at the level of parts per billion or less. Liquid chromatography is becoming increasingly popular in qualitative and quantitative analyses. Although less sensitive, if offers the capability of analyzing polar compounds without derivatization. (See also W87-09280) (Lantz-PTT)
W87-09295

BIOACCUMULATION,
Purdue Univ., West Lafayette, IN. Dept. of Forestry and Natural Resources.
A. Spacie, and J. L. Hamelink.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 495-525, 14 fig, 5 tab, 134 ref.

Descriptors: *Bioaccumulation, *Path of pollutants, *Toxicity, *Water pollution effects, Fate of pollutants, Organic compounds, Aquatic environment, Model studies, Kinetics, Toxicity.

A small number of the trace contaminants in aquatic ecosystems pose an environmental hazard because of their great toxicity or persistence. Nevertheless, it is now possible to measure bioaccumulation potential and, in many cases, to predict potential residue problems before they develop. New organic chemicals can be evaluted according to their partition coefficients and rates of biodegradation. Those with moderate to high partition coefficients can be tested for bioconcentration and, if necessary, bioaccumulation potential. Depuration rate constants can also be used to predict loss of residues from contaminated organisms following pollution abatement. The type of kinetic model and testin scheme chosen for measuring bioaccumulation depends largely on the level of detail required. One-compartment models, log P correlations, and short-term tests are adequate for prescreening the great majority of chemicals. Those that 'look suspicious' in preliminary tests can be scrutiniqed more carefully in bioaccumulation or food chain transfer tests. The internal dynamics of residues within the body can also be studied for especially hazardous materials. Whatever the level of detail, the primary goal in designing a bioaccumulation test should be to produce data that can be interpreted and evaluted in terms of a clearly defined conceptual model. (See also W87-09280) (Lantz-PTT)
W87-09296

BIOTRANSFORMATION,
The Medical Coll. of Wisconsin, Milwaukee. Dept. of Pharmacology and Toxicology.
J. J. Lech, and M. J. Vodicnik.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 526-557, 16 fig, 6 tab, 50 ref.

Descriptors: *Toxicity, *Biotransformation, *Fate of pollutants, *Water pollution effects, *Fish physiology, Enzymes, In-vitro tests, Tissue analysis, Monitoring, Fish, Chemical analysis, Benzphetamine-N-demethylase, Gluconyl transferase, Ethylmorphine-N-demethylase.

Enzymatic biotransformation reactions can be broadly divided into two types: phase I nonsynthetic reactions, involving oxidation, reduction, and hydrolysis; and phse II synthetic reactions, involving conjugation. These studies indicate that fish can biotransform a variety of substrates, but the rates observed were generally lower than those in many mammalian species. A reasonable amount of evidence indicates that phase I reactions observed in fish in vitro are catalyzed by the microsomal cytochrome P-450 system, which has been extensively investigated in mammals. Benzphetamine-N-demethylases and ethylmorphine-N-demethylase

activities have been observed in hepatic microsomes of fish, indicating that a system comparable to the cytochrome P-450 system of mammals exists in fish, although it appears to be refractive to induction by drdugs and chaemicals that produce phenobarbital-type induction in mammals. Phase II reactions have been demonstrated in vitro with tissue preparations from a variety of fish species, and it is clear that glucuronyl transferase, sulfotransferase, glutathione-S-transferase and epoxide hydrolase activities are, at least qualitatively, similar to those in mammals. Although in vitro studies have been extremely useful in characterizing the enzymes involved in the biotransformation of chemicals in fish, an area of equal or greater importance is concerned with the functional significance of these biotransformations reactions in vivo. Almost every biotransformation reaction (phase I and phase II) that has been described in vitro in fish has been demonstrated in vivo during exposure of live fish to a variety of chemicals and pesticides. Metabolites arising from biotransformation reactions have been identified in fish tissues including liver, bile, and urine. (See also W87-09280) (Lantz-PTT)
W87-09297

FATE MODELING,
Environmental Research Lab., Athens, GA.
L. A. Burns, and G. L. Baughman.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 558-584, 9 fig, 54 ref.

Descriptors: *Fate of pollutants, *Model studies, *Water pollution effects, *Aquatic toxicology, *Toxicity, Mathematical models, Environmental effects, Quantitative analysis, Monitoring, Acute effects, Chronic effects.

Environmental fate models can be used to assemble chemical and environmental information into an objective mathematical description of the behavior of chemical substances in aquatic ecosystems. When this information is supplemented with a knowledge of potential or actual releases of chemicals to water bodies (loadings), the resulting exposure concentrations, magnitudes of the fate processes, and persistence of the chemical can be estimated in a quantitative, systematic framework. Much of this information, when coupled with the results of toxicological investigations, is of direct utility in evaluating the risk or hazard posed by chemical releases to the environment. Toxicological and ecological effects studies are of two kinds: (1) short-term or acute experiments and (2) longer-term or chronic experiments. Acute studies are often used to determine the concentration of a chemical that results in mortality of 50% of a test population over a period of hours to days. Chronic studies examine sublethal effects on populations exposed to lower concentrations over extended periods. Toxicological investigations, environmental chemistry, and ecological modeling can be successfully combined in a risk analysis or a hazard assessment only when practitioners in these disciplines agree on the scientific issues involved. This chapter introduces the tools and perspectives brought to risk assessment by chemistry, mathematical modeling, and system analysis. It provides both an overview and a detailed exposition of some of the fundamental tools of environmental chemistry and modeling. Chemical hydrolysis and acid-base equilbria are used to analyze the kinetics of transformation processes, and the application of chemnical fate models in toxicological investigations is demonstrated by teh example of flow-trhough toxicity tests of a simple mixture. (See also W87-09280) (Lantz-PTT)
W87-09298

CHEMICAL SAFETY EVALUATION,
Exxon Corp., East Millstone, NJ. Medical Dept.
A. W. Maki, and W. E. Bishop.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 619-635, 3 fig, 7 tab, 22 ref.

Descriptors: *Toxicity, *Fate of pollutants, *Water pollution effects, *Evaluation, *Chemical pollutants, *Risk assessment, *Aquatic toxicology, Environmental effects, Surface waters, Aquatic environment.

A conceptual framework has been developed for assessing the hazard of chemical substances to aquatic life. A risk assessment is based on the relationship between the environmental exposure concentration of the material and the concentration showing some adverse biological effect. Satisfactory approaches and methods are available for predicting the environmental fate of chemicals, and test methods exist for determining adverse biological effects. However, there is a need for further refinements in both of these critical components of risk assessment. Although risk assessment procedures are in the developmental stages, it is evident that the respective approaches have reasonable philosophical foundations and are functional. They need, however, to be tested with data on chemical substances for which longer-term use has defined the safety for aquatic life. After such testing it is highly probable that refinements will be needed in the procedures. In addition, the criteria used in the procedures to make decisions on the need for additional testing must be scrutinized to establish their scientific credibility. Such scrutiny can only come after repeated applications of these assessment procedures to a wide variety of test substances that have the potential to reach surface waters. (See also W87-09280) (Lantz-PTT)
W87-09301

EFFLUENT EVALUATION,
EG and G Environmental Group, Wellesley, MA.
For primary bibliographic entry see Field 5A.
W87-09302

GROUNDWATER TRANSPORT: HANDBOOK OF MATHEMATICAL MODELS,
California Univ., Berkeley. Lawrence Berkeley Lab.
I. Javandel, C. Doughty, and C.-F. Tsang.
Water Resources Monograph Series 10. American Geophysical Union, Washington, DC. 1984. 228 p.

Descriptors: *Path of pollutants, *Groundwater pollution, *Mathematical models, *Model studies, *Groundwater movement, Pesticides, Herbicides, Fertilizers, Industrial wastes, Municipal wastes, Mathematical studies.

Concerns over groundwater pollution have resulted in the passage of legislation during the last decade calling for pollution control and remedial measures to ensure proper drinking water quality. There are two main types of groundwater pollution caused by man: (1) pollution caused by the use of pesticides, herbicides, and fertilizers over agricultural lands, where the source of contamination covers a relatively large area, and (2) pollution caused by industries and municipalities, which is generally more localized. For the second type, because the contamination in the groundwater is localized, the design of any remedial measure requires knowledge of the extent of the contaminant plume. Various mathematical methods may be used for estimating the size, shape, and development of a localized contaminant plume. It is the need for these mathematical methodologies that forms the main impetus for the preparation of this book. This handbook consists of three major sections, corresponding to three levels of complexity. The sections cover (1) analytical, (2) semianalytical, and (3) numerical methods of predicting the extent of subsurface contamination, respectively. Each section consists of a brief description of the background and fundamental theory of the method, followed by solutions to several selected mathematical models. The advantages and limitations of each method are discussed at the end of each section. Simple computer programs (including a user's guide for each) are listed in appendices for the evaluation of analytical solutions. The section on semianalytical methods addresses three types of field problems. The first studies field problems that include arbitrary numbers of recharge and discharge wells tapping an aquifer having a pronounced uniform flow field. The second expands the applicability of the first procedure to problems including circular recharge ponds with finite radii. The use of a production well for mapping a contaminant concentration distribution within an aquifer is demonstrated in the third type of problem. A complete set of computer programs and user's guides is provided to enable easy application of these methods. Application of these models is demonstrated through several problems with various degrees of complexity. (Lantz-PTT)
W87-09306

SEPTIC TANK SYSTEM EFFECTS ON GROUND WATER QUALITY,
Oklahoma Univ., Norman. Environmental and Ground Water Inst.
For primary bibliographic entry see Field 5C.
W87-09310

PHYSICAL AND CHEMICAL BEHAVIOR AND ENVIRONMENTAL ACCEPTABILITY OF STABILIZED SCRUBBER SLUDGE AND FLY ASH IN SEAWATER,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
I. W. Duedall, F. J. Roethel, J. D. Seligman, S. A. Oakley, and J. H. Parker.
IN: Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms, A Symposium Sponsored by ASTM Committee D-19, Ft. Lauderdale, FL, 29-30 January 1979. ASTM STP 730, 1981. p 289-306, 7 fig, 6 tab, 15 ref.

Descriptors: *Environmental effects, *Sludge, *Water disposal, *Fly ash, *Water pollution effects, *Long Island Sound, *Conscience Bay, Ecological effects, Heavy metals, Leaching, Ocean dumping, Reefs.

Flue gas desulfurization sludges and fly ash pose a major disposal problem for coal-burning power plants. Disposal of stabilized, blocklike forms of these waters in the ocean in the form of a reef is an alternative being studied at the Marine Sciences Research Center, Stony Creek, N.Y. In laboratory experiments, physical integrity studies and components species leaching rates indicate that, in general, stabilization was found to maintain the strength of the blocks and minimize trace metal leachings in aerobic seawater over prolonged exposure. In field studies, which are in progress, in blocks (0.028 cu m) of stabilized scrubber sludge and fly ash were placed in approximately 6 m of water in Conscience Bay near Long Island Sound. Within 3 weeks after placement of the coal waste reef and the control structure, a heavy crop of attached plants and animals were observed growing on both reefs. The organisms attached to the coal waste reef showed no elevation in heavy metals in relation to the heavy metal composition of organisms attached to the concrete control. (See also W87-09311) (Author's abstract)
W87-09327

PETROLEUM SPILLS IN THE MARINE ENVIRONMENT: THE CHEMISTRY AND FORMATION OF WATER-IN-OIL EMULSIONS AND TAR BALLS,
Science Applications International Corp, La Jolla CA. Div. of Applied Environmental Sciences.
J. R. Payne, and C. R. Phillips.
Lewis Publishers, Inc., Chelsea, MI. 1985. 148 p.

Descriptors: *Oil spills, *Chemical properties, *Water pollution treatment, *Marine environment, *Fate of pollutants, Tar balls, Emulsions, Cleanup operations, Model studies, Case studies, Path of pollutants, Seawater, Oil pollution, Oil-water interfaces, Oily water.

Presented is an overview of the current understanding of water-in-oil emulsion behavior. It is based on a review originally prepared as a contribution to the NAS Petroleum in the Marine Environment/Update Workshop held in November, 1981. When crude oils or refined petroleum products are released at sea, they are subjected immediately to a wide variety of weathering processes. These processes cause significant changes in the rheological properties of the oil, several orders of magnitude increases in viscosity, factor of two

changes in interfacial surface tensions, and appreciable (5-10%) changes in oil density. All of these alterations have important implications for the subsequent spill cleanup or containment strategy. The increase in volume due to incorporation of water in emulsions can cause further problems for storing the collected product. Specific laboratory studies on water-in-oil emulsions with a variety of crude and refined petroleum productions are discussed in detail in Chapter 2. This information, along with the data on the component concentrations of wax, asphaltene, and other surface-active materials, facilitates reliable predictions on whether or not a particular crude or refined product will form a stable emulsion. Chapter 3 covers case histories of real spill events with discussion of specific studies of water-in-oil emulsions and the chemistry of emulsion formation and behavior. The chemical composition of tar balls, their sources, fate, and global distribution are discussed in Chapter 4. Chapter 5 is an overview of recent attempts to model water-in-oil emulsification behavior. Chapter 6 presents a summary and critical citation review for easy reference to additional details on particular topics presented in the other chapters. (Lantz-PTT)
W87-09339

DECREASE IN PRECIPITATION ACIDITY RESULTING FROM DECREASED S04(2-) CONCENTRATION,
Yale Univ., New Haven, CT. Dept. of Biology.
L. O. Hedin, G. E. Likens, and F. H. Boreman.
Nature NATUAS, Vol. 325, No. 6101, p 244-246. January 1987. 2 fig, 1 tab, 25 ref.

Descriptors: *Path of pollutants, *Acid rain, *Sulfur dioxide, *Sulfates, Emissions, Rainfall, Acidity, Precipitation.

The effects of decreases in S02 emissions on precipitation acidity has received much attention, but there has been no direct quantification of how recent decreases in S02 emissions in the Northeastern and Midwestern United States have affected precipitation acidity at a local site. Yet such quantification is an important step in assessing the effectiveness of control measures for S02 emissions. It is thought than recent decreases in S04(2-) concentration in precipitation acidity is obscured by long term trends in other ions, which also influence acidity. It is shown that, given the observed trends in concentration of other ions, the H(+) concentration in 1983 would have been nearly two thirds higher than the measured value if the S04(2-) concentration had not decreased. (Author's abstract)
W87-09348

METAL PRECIPITATION IN TWO LANDFILL LEACHATES,
Michigan Univ., Ann Arbor.
For primary bibliographic entry see Field 5G.
W87-09368

LABORATORY AND INSTREAM NITRIFICATION RATES FOR SELECTED STREAMS,
Environmental Protection Agency, Athens, GA.
For primary bibliographic entry see Field 2H.
W87-09378

HEAVY METAL CONCENTRATIONS IN THE LIVER OF THREE DUCK SPECIES: INFLUENCE OF SPECIES AND SEX,
Environmental and Community Medicine, UMDNJ-Robert Wood Johnson Medical School, Piscataway, NJ 08854, USA.
M. Gochfeld, and J. Burger.
Environmental Pollution, Vol. 45, No. 1, p 1-15, 1987. 1 fig, 3 tab, 50 ref.

Descriptors: *Path of pollutants, *Bioaccumulation, *Heavy metals, *Ducks, *Raritan Bay, Tissue analysis, Liver.

To investigate interspecific and intersex differences in heavy metal levels, we analyzed concentrations of cadmium, cobalt, chromium, copper, lead, mercury, manganese, nickel and zinc in the livers of male and female black duck (Anas rubripes), mallard (A. platyrhynchos) and greater scaup (Aythya marila) collected in Raritan Bay, New Jersey in December 1980 and January 1981. Certain metal levels varied significantly by species and sex. In all species, Zn and Cu had the highest concentrations, and Cd, Co, and Hg were lowest in all three species. Scaup had significantly higher levels of Mn and Zn than black duck and scaup. Overall, eight of nine metal levels were higher in male than female black duck. In scaup, females had significantly higher levels of Pb and Mn than males. In black ducks, males had significantly higher levels of Cu, Mn and Zn than females. The sample of mallard was too small to test intersex differences. (Author's abstract)
W87-09380

FATE OF SOME COMPONENTS OF ACIDIC DEPOSITION IN OMBROTROPHIC MIRES,
Dept. of Botany, Univ. of Manchester, Manchester M13 9PL, Great Britain.
S. J. Woodin, and J. A. Lee.
Environmental Pollution, Vol. 45, No. 1, p 61-72, 1987. 6 fig, 1 tab, 32 ref.

Descriptors: *Fate of pollutants, *Acid rain, *Sphagnum, *Path of pollutants, *Nitrogen compounds, Deposition, Nitrates, Rainfall, Enzymes, Vegetation, Air pollution.

The ability of ombrotrophic Sphagnum species to immobilize inorganic nitrogen deposited from the atmosphere was investigated in a series of simple lysimeter experiments. In an unpolluted mire, Sphagnum fuscum mats retained all the nitrogen deposited to them in natural precipitation events. Sphagnum capillifolium mats, transplanted from an unpolluted site to the polluted southern Pennines in England, also initially retained a large proportion of deposited nitrate and ammonium. However, a laboratory experiment demonstrated that high rates of nitrogen supply cause a loss of the ability of the moss to retain nitrate, which suggest that this may occur as a result of increased nitrogen deposition in polluted regions, resulting in increased nitrate availability in the peat. Investigation of the volume of precipitation and amounts of sulfate and chloride passing through the Sphagnum mats in the southern Pennines, as compared to that collected in adjacent bulk deposition gauges, showed that conventional deposition monitoring grossly underestimates rates of deposition to vegetation. Efficient trapping of occult and dry deposition by the moss led to much greater volumes of precipitation and amounts of sulfate and chloride being measured in through flow than in bulk precipitation samples. Physiological response of S. fuscum to occult precipitation and heavy rainfall was investigated by measuring nitrate reductase activity induced in the moss by nitrate supplied in 'fine mist' and 'large droplet' applications of solutions to moss in the field. Greater response was shown to occult deposition, suggesting that this form of precipitation may be important in vegetation damage in polluted regions. (Author's abstract)
W87-09382

BIODEGRADATION OF TRICHLOROETHYLENE AND INVOLVEMENT OF AN AROMATIC BIODEGRADATIVE PATHWAY,
Technology Applications, Inc., Gulf Breeze, FL 32561.
For primary bibliographic entry see Field 5D.
W87-09387

POTENTIAL FOR TRANSDUCTION OF PLASMIDS IN A NATURAL FRESHWATER ENVIRONMENT: EFFECT OF PLASMID DONOR CONCENTRATION AND A NATURAL MICROBIAL COMMUNITY ON TRANSDUCTION IN PSEUDOMONAS AERUGINOSA,
Dept. of Biochemistry and Biophysics, Stritch School of Medicine, Loyola Univ. of Chicago, Maywood, IL 60153.
For primary bibliographic entry see Field 2H.
W87-09390

MAINTENANCE AND STABILITY OF INTRODUCED GENOTYPES IN GROUNDWATER AQUIFER MATERIAL,
Tennessee Univ., Knoxville. Dept. of Microbiology.
R. K. Jain, G. S. Sayler, J. T. Wilson, L. Houston, and D. Pacia.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 5, p 996-1002, May 1987. 6 fig, 3 tab, 21 ref. EPA Cooperative agreement CR810485.

Descriptors: *Genotypes, *Groundwater pollution, *Aquifers, *Bacteria, *Microbiological studies, Hybridization, Incubation, Biodegradation.

Three indigenous groundwater bacterial strains and Pseudomonas putida harboring plasmids TOL (pWWO) and RK2 were introduced into experimentally contaminated groundwater aquifer microcosms. Maintenance of the introduced genotypes was measured over time by colony hybridization with gene probes of various specificity. On the basis of the results of colony hybridization quantitation of the introduced organisms and genes, all introduced genotypes were stably maintained at approximately 100000 positive hybrid colonies/g of aquifer microcosm material throughout an 8-week incubation period. Concomitant removal of the environmental contaminants, viz., toluene, chlorobenzene, and styrene, both natural (uninoculated) and inoculated aquifer microcosms was also demonstrated. The results indicate that introduced catabolic plasmids, as well as indigenous organisms, can be stably maintained in groundwater aquifer material without specific selective pressure for the introduced genotypes. These results have positive implications for in situ treatment and biodegradation in contaminated aerobic groundwater aquifers. (Author's abstract)
W87-09391

MICROBIALLY MEDIATED LEACHING OF LOW-SULFUR COAL IN EXPERIMENTAL COAL COLUMNS,
Maryland Univ., Solomons. Center for Environmental and Estuarine Studies.
J. C. Radway, J. H. Tuttle, N. J. Fendinger, and J. C. Means.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 5, p 1056-1063, May 1987. 7 fig, 1 tab, 23 ref. Maryland Dept. of Natural Resources Grant P97-84-04.

Descriptors: *Acid mine drainage, *Path of pollutants, *Leaching, *Mine wastes, *Sulfur bacteria, Simulated rainfall, Cultures, Bacteria, Sulfur, Microbiological studies, Coal, Growth.

The leaching of a low-sulfur bituminous coal was investigated with experimental coal columns subjected to simulated rainfall events. Leachates from the columns became dominated by iron-oxidizing bacteria as evidenced by specific enrichment cultures and measurements of CO2 assimilation. Heterotrophic microorganisms were also present in the coal leachates, but their numbers and activity decreased with decreasing pH. This pattern could be reversed by increasing the pH of the coal with lime. Organosulfur-utilizing bacteria made up a substantial portion of the heterotrophic community. Measurements of microbial activity in coal cores indicated that although much of the microbial community remained associated with coal particles, the relative abundance of heterotrophs and autotrophs in leachate seemed to reflect that in coal cores. When bacterial growth was delayed by autoclaving coal samples, acid production and leaching of iron and sulfur were also delayed. Rapid leaching of materials from coal thus appears to be strongly dependent on the presence of the natural bacterial microflora. (Author's abstract)
W87-09393

SELENIUM IN THE TRIBUTARIES OF THE ORINOCO IN VENEZUELA,
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
For primary bibliographic entry see Field 2K.
W87-09406

ENVIRONMENTAL ASPECTS OF ENERGY RELATED SOLID WASTE,
National Center for Analysis of Energy Systems, Upton, NY. Biomedical and Environmental Assessment Div.
For primary bibliographic entry see Field 5E.
W87-09427

LEACHING BEHAVIORS OF LOW-SULFUR COALS AND COAL WASTES FROM THREE WESTERN COAL PREPARATION PLANTS,
Los Alamos National Lab., NM.
R. C. Heaton, L. E. Wangen, J. A. O'Rourke, A. M. Nyitray, and M. M. Jones.
Available from the National Technical Information Service, Springfield, VA 22161, as DE83-002309, A03 in paper copy, A01 in microfiche. LA-9492-MS, UC-90i, September 1982. 44 p, 4 tab, 12 ref, 3 append.

Descriptors: *Water pollution sources, *Fate of pollutants, *Mine wastes, *Industrial wastes, *Coal wastes, Leachates, Coal, Spoil banks, Trace elements.

Low-sulfur coal and coal waste samples from three coal preparation plants located in the western United States were examined to determine whether storage piles or waste piles composed of these materials might release contaminated drainages into the environment. These studies revealed that, as far as trace element releases are concerned, such western coal and coal waste piles pose no threat to environmental quality. Leachates obtained through laboratory leaching tests were neutral or very slightly alkaline in pH and contained negligible amounts of most trace elements. All elements studied were within acceptable limits according to the Environmental Protection Agency Multimedia Environmental Goals/Minimum Acute Toxicity Effluent system of evaluation. According to x-ray diffraction data, these samples contain only small amounts of pyrite, no strongly alkaline minerals, and detectable levels of carbonate minerals such as calcite and dolomite, which are capable of buffering the pH in the neutral range. The major mineral components detected were quartz, plagioclase feldspars, and mixed-layer micaceous or montmorillonite-type clays. These latter components often serve as repositories for trace elements that can be mobilized under appropriate leaching conditions. We ascribe the innocuous leaching behaviors of these materials to the neutral pH of the leachates, a condition that renders most trace elements immobile. If other materials capable of altering the pH of the leachates are mixed with or codisposed with coal wastes of this type, the resulting mixtures may release trace elements in significant amounts. (Author's abstract)
W87-09429

LLNL GROUNDWATER QUALITY: SAMPLING OF SEVEN SHALLOW WELLS ON THE LLNL SITE,
Lawrence Livermore National Lab., CA.
L. L. Rogers.
Available from the National Technical Information Service, Springfield, VA 22161, as DE83-001844, A03 in paper copy, A01 in microfiche. UCID-19564, September 17, 1982. 40 p, 12 fig, 12 tab, 20 ref. Contract No. W-7405-Eng-48.

Descriptors: *Fate of pollutants, *Groundwater, *Water quality, *Path of pollutants, Lawrence Livermore National Laboratory, California.

The Lawrence Liverpool National Laboratory (LLNL) Site Hydrogeologic Investigation was initiated to evaluate the effect that the LLNL operations have on local groundwater quality. A task of the first phase of the investigation was to characterize the existing groundwater quality beneath the site. Seven shallow water table wells from the LLNL groundwater observation network were sampled. Four of the wells were sampled using a submersible centrifugal pump, and the other three were sampled by means of a bailer. A variety of analyses were performed including determinations of major cations and anions, total dissolved solids, total organic carbon, trace organic compounds (including two polychlorinated biphenyl analyses), gamma spectra, and tritium content. The analyses add useful resolution to the regional picture of groundwater quality and suggest some alterations of previous geochemical mapping. No contaminants were detected in any of the samples that would preclude the use of the water below the LLNL site for drinking. (Author's abstract)
W87-09458

ORIENTATION STUDY OF ST. FRANCOIS MOUNTAIN AND DECATURVILLE PRECAMBRIAN AREAS, MISSOURI,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 2K.
W87-09459

WATER QUALITY ASSESSMENT: A SCREENING PROCEDURE FOR TOXIC AND CONVENTIONAL POLLUTANTS, PART 1,
Tetra Tech, Inc., Lafayette, CA.
W. B. Mills, J. D. Dean, D. B. Porcella, S. A. Gherini, and R. J. M. Hudson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-153122, A25 in paper copy, A01 in microfiche. EPA-600/6-82-004a, September 1982. 570 p, 89 fig, 126 tab, 239 ref. Contract No. 68-03-2673.

Descriptors: *Water analysis, *Water quality assessment, *Chemical analysis, *Water pollution control, Environmental protection, Water quality, Water quality control, Water quality management, Pollutants, Water law, Legal aspects.

New technical developments in the field of water quality assessment and a rendering of water quality priorities prompted a revision of Water Quality Assessment: A Screening Methodology for Nondesignated 208 Areas (EPA-600/9-77-023). The utility of the revised manual is enhanced by the inclusion of information on the accumulation, transport, and fate of toxic chemicals in the environment. The new subtitle---A Screening Procedure for Toxic and Conventional Pollutants---reflects the added data. Applying the manual's simple techniques, the user is now capable of assessing the loading and fate of conventional pollutants (temperature, biochemical oxygen, demand-dissolved oxygen, nutrients, and sediments) and toxic pollutants (from the U.S. EPA list of priority pollutants) in streams, impoundments and estuaries. The techniques are readily programmed on hand-held calculators. Most of the data required for using these procedures are contained in the manual. Part I contains the introduction and chapters on the aquatic fate of toxic organic substances, waste load calculations, and the assessment of water quality parameters in rivers and streams. (Author's abstract)
W87-09462

SWINE LAGOON EFFLUENT APPLIED TO COASTAL BERMUDAGRASS,
North Carolina State Univ. at Raleigh. School of Agriculture and Life Sciences.
For primary bibliographic entry see Field 5D.
W87-09472

VULNERABILITY OF SELECTED LAKES AND STREAMS IN THE MIDDLE ATLANTIC REGION TO ACIDIFICATION: A REGIONAL SURVEY,
Pennsylvania Cooperative Fish and Wildlife Research Unit, University Park.
D. E. Arnold, R. W. Light, and E. A. Paul.
Biological Report 80(40.19), June 1985. 133 p, 24 fig, 29 tab, 68 ref, 3 append.

Descriptors: *Acidic water, *Fate of pollutants, *Acid rain, *Lakes, *Acid streams, *Surveys, Hydrogen ion concentration, Acid rain, Acidity, Calcium, Magnesium, Minerals, Alkalinity, Streams, Conductivity, Water quality, Models, Regional analysis.

Sampling of 278 lakes and streams in the nine Middle Atlantic States showed that about 49% of the unpolluted, relatively undeveloped waters were sensitive to acidification on the basis of having alkalinity <200 microeq/liter or of having underlying bedrock of low acid neutralizing capacity. Alkalinity in the waters studied had decreased in recent years. Few of the waters showed high concentrations of Al. Sulfate levels (mean 227 microeq/liter) found in the sampled waters were higher than those from areas where precipitation is acidic, and much higher than those from areas with nonacidic precipitation. In general, pH was correlated strongly with alkalinity, conductivity, and (negative) calcite saturation index, and weakly with Ca, Mg, and disturbance. Alkalinity was strongly correlated with Ca, pH, conductivity, and Mg, and weakly with sulfate, chloride, disturbance, rain pH, and (negative) elevation. Neither pH nor alkalinity was strongly correlated with Al, Mg, color, total organic carbon, or size of waters. Differences in water chemistry between lakes and streams were small, with streams in general being less acidic. The calcium-pH model of Henriksen predicted the pH of waters in the study area reasonably well. It indicated that about 28% of the waters were acidified. The study results indicate that a large number of relatively undisturbed waters in the Middle Atlantic States are either already acidified or are susceptible to acidification. (Geiger-PTT)
W87-09476

1984 ANNUAL REPORT TO THE PRESIDENT AND CONGRESS: NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM.
Interagency Task Force on Acid Precipitation, Washington, DC.
1984. 102 p, 15 fig, 13 tab.

Descriptors: *Acid rain, *Water pollution sources, *Water pollution effects, *Research priorities, *Fate of pollutants, Decision making Management planning, Air pollution, Water pollution, Project planning , Acidic water, Future planning, Planning.

Summaries are presented of the major scientific issues that were addressed by the National Acid Precipitation Assessment Program in 1984, and the progress of researchers in reducing the uncertainties of assessing causes, effects, and management of acid deposition. The report has four parts. Part one provides information about the Task Force's and National Program's Program's history, organization, funding, and management. Part two discusses selected factors influencing the evolution of the study of acid deposition. The third part contains an overview of the progress and specific accomplishments within each research area of the National Program. The overviews in part three are the core of this report and include the following topics: natural sources, man-made sources, atmospheric processes, deposition monitoring, aquatic effects, terrestrial effects, effects on materials and cultural resources, control technologies, assessments, and international activities. Within each research area's overview section are discussions of the research goals, accomplishments, and proposed future activities. The final part lists the easily accessible publications produced by the National Program. (Geiger-PTT)
W87-09479

EVALUATION OF THE MODEL CE-QUAL-R1 FOR USE BY THE AQUATIC PLANT CONTROL RESEARCH PROGRAM,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. H. Wlosinski.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA 110826, A04 in paper copy, A01 in microfiche. Technical Report A-81-6, December 1981. Final Report. 60 p, 8 fig, 6 tab, 24 ref.

Descriptors: *Aquatic plants, *Weed control, *Reservoirs, *Water quality, Model studies, Mathematical models, CE-QUAL-R1 model, Aquatic weed control, Lake Conway, Florida, Zooplankton, Algae, Thermal stratification, Nutrients.

The Corps of Engineers One-Dimensional Reservior Water Quality Model (CE-QUAL-R1) was

evaluated for use in the Aquatic Plant Control Research Program (APCRP). This was accomplished by applying the model to a set of data collected at Lake Conway, Florida. Calibration of the thermal portion of the model for a period of one year and subsequent verification for a period of three years produced satisfactory results concerning the water budget and temperature predictions. Calibration of the water quality portion of the model also produced satisfactory results. Measured data were not considered satisfactory for model verification. It was concluded that CE-QUAL-R1 would be useful to the APCRP for predicting water quality variables after the addition of a macrophyte algorithm and after improvements are made concerning the interaction between the algorithms, timestep, and solution scheme. All current model developments within the Environmental Water Quality Operational Studies Program should enhance model use for the APCRP. Other possible improvements which should be considered include the incorporation of (a) output dealing with system function, (b) input via rainfall, and (c) effects of wind on sediments. (Author's abstract)
W87-09486

FIELD SURVEY OF HEAVY METAL UPTAKE BY NATURALLY OCCURRING SALTWATER AND FRESHWATER MARSH PLANTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. W. Simmers, B. L. Folsom, C. R. Lee, and D. J. Bates.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA 101662, A08 in paper copy, A01 in microfiche. Technical Report EL-81-5, June 1981. Final Report. 161 p, 35 fig, 17 tab, 23 ref, 7 append.

Descriptors: *Fate of pollutants, *Metals, *Marshes, *Sediments, Heavy metals, Marsh plants, Baseline studies, Bioaccumulation, Accumulation, Great Lakes, Gulf Coast, Coastal marshes, Manganese, Zinc, Cadmium, Iron, Cyperus, Spartina alterniflora, Anaerobic conditions, Dredging, Salt marshes, Spoil disposal, Spoil banks.

A natural marsh heavy metal survey was conducted to establish a baseline for comparison to plant concentration and uptake data from contaminated and perturbated sediments. Extensive field sampling of natural marshes was conducted along the East and Gulf coasts of the U.S., and along the shores of the Great Lakes. Spartina alterniflora was collected from the seawater marshes and Cyperus species were collected from freshwater marsh areas. Results indicated that, in the saltwater marsh, manganese and zinc concentrations were slightly lower than those previously determined in greenhouse and disposal site studies with contaminated sediments, while the concentrations of the remainder of heavy metals were similar. Calculation of total uptake values indicated that only cadmium may be of concern. Cadmium levels in Cyperus species in naturally occurring marshes were similar to those of a greenhouse flooded (reduced) environment. Iron and manganese were generally present in lower concentration in the natural marsh than in the greenhouse plants grown on contaminated sediment, while the remainder of the heavy metals examined were present in higher concentrations. This investigation forms the basis for the conclusion that marsh plants grown on contaminated dredged material in a flooded environment do not bioconcentrate excessive or even significantly higher levels of toxic metals than those same plant species in naturally occurring marshes. (Author's abstract)
W87-09490

STREAM WATER QUALITY IN THE COAL REGION OF VIRGINIA,
Northeastern Forest Experiment Station, Broomall, PA.
For primary bibliographic entry see Field 4C.
W87-09494

WATER-QUALITY MONITORING AT THE HOE CREEK TEST SITE: REVIEW AND PRELIMINARY CONCLUSIONS,
Lawrence Livermore National Lab., CA.
F. T. Wang, S. W. Mead, and D. H. Stuermer.
Available from the National Technical Information Service, Springfield, VA 22161, as DE82-015759, A03 in paper copy, A01 in microfiche. UCRL--87650, July 1982. 41 p, 21 fig, 7 tab, 8 ref. Contract No. W-7405-ENG-48.

Descriptors: *Water pollution sources, *Fate of pollutants, *Coal gasification, *Aquifers, *Groundwater monitoring, *Wyoming, Gasification, Monitoring, Hoe Creek, Sand, Ammonia, Phenols, Organic compounds, Metals, Leaching, Pyrolysis, Calcium, Magnesium, Sulfates, Potassium, Lithium Chlorides.

Groundwater monitoring at the Hoe Creek, Wyoming, underground coal gasification site showed that sorption of organic contaminants by coal was not as extensive as expected, probably because of the limited surface area of the coal. Samples were collected from two gasified coal seam aquifers and an overlying channel sand aquifer. The three aquifers has been interconnected by a roof collapse. Within the gasification cavity ammonia, fluoride, boron, sulfide, chloride, and silicate increased after gasification and persisted in the cavity groundwater. Substances in the gasification cavity which appeared, then decreased, after gasification included phenols, sulfate, calcium, magnesium, potassium, and lithium. In the two coal aquifers (outside the gasification area) contaminant levels varied considerably, depending on the rate of groundwater flow and location of fractures. The sand aquifers showed much less contamination by pyrolysis products than did the coal aquifers. Escaping hot gases cause further pyrolysis products in the coal aquifers but no pyrolysis in the sand aquifer. Concentrations of calcium, magnesium, and other metals in all aquifers increased soon after gasification. This was attributed to carbon dioxide formed during gasification, which dissolved in water and facilitated mobilization of metal ions. (Cassar-PTT)
W87-09495

PROCESSES AFFECTING THE DISTRIBUTION OF LOW-MOLECULAR-WEIGHT ALIPHATIC HYDROCARBONS IN COOK INLET, ALASKA,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
C. N. Katz, and J. D. Cline.
NOAA Technical Memorandum ERL PMEL-26, April 1981. 84 p, 46 fig, 9 tab, 78 ref, 2 append.

Descriptors: *Water pollution sources, *Oil wells, *Hydrocarbons, Aliphatic hydrocarbons, Cook Inlet, Alaska, Tidewater, Methane, Estuaries, Ethene, Propene, Butane, Ethane, Sediments, Marine sediments, Bottom sediments.

Measurements of low-molecular-weight aliphatic hydrocarbons, C1 to C4, were made in Cook Inlet, Alaska, on five cruises between 1977 and 1979. The distributions of these compounds were variable in both space and time. Conception levels and composition of these gases in the lower Inlet appeared to be typical of those found in other coastal marine environments. The upper Inlet, however, had significantly elevated concentrations of methane and the C2 and greater paraffins. On the basis of the contrasting hydrographic conditions of the two regions and the differing compositional characteristics of the hydrocarbon assemblages, the source of hydrocarbons was qualitatively determined to be predominantly biogenic in the lower Inlet thermogenic in the upper Inlet. Hydrocarbon analyses made in concert with biological measurements in the lower Inlet suggested that the major source of methane was from the sediments, whereas the C2 and greater hydrocarbons were produced in the water column. The conclusions of these field studies were supported by in vitro experiments. A methane budget calculated on the basis of a two-box model of the Inlet showed air-sea exchange and tidal mixing to be the major sinks of hydrocarbons in the Inlet. The budget quantitatively supported the evidence of thermogenic source of hydrocarbons in the upper Inlet. This source may be the result of submarine seepage or leakage from existing wells. (Author's abstract)
W87-09506

PROCEEDINGS: 1981 OIL SPILL CONFERENCE (PREVENTION, BEHAVIOR, CONTROL, CLEANUP).
American Petroleum Inst., Washington, DC.
March 2-5, 1981, Atlanta, GA. 742 p. + errata.

Descriptors: *Oil spills, *Cleanup operations, *Conferences, *Environmental effects, Dispersants, Cold regions, Model studies, Case histories, Oil recovery, Brackish water, Natural waters, Oil, Oily water, Legal aspects, Oil pollution.

The biennial Oil Spill Conference Proceedings have been recognized world-wide as the authority for state-of-the-art information on oil spill equipment, regulation, and cleanup techniques, as well as the impacts resulting from social and legal forces. This 1981 Oil Spill Conference Proceedings presents a distinguished, international exchange of information with session sections covering topics such as: dispersants, laboratory and effluent water studies, training, modeling, cold water studies, case histories, petroleum in fresh and brackish waters, near-shore sediment studies, socioeconomic and legal aspects, offshore platform studies, and contingency planning. (See W87-09508 thru W87-09567) (Lantz-PTT)
W87-09507

BIODEGRATION OF CHEMICALLY DISPERSED CRUDE OIL,
Department of the Environment, Victoria (British Columbia). Inst. of Ocean Sciences.
W. J. Cretney, R. W. Macdonald, C. S. Wong, D. R. Green, and B. Whitehouse.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 37-43, 6 fig, 26 ref.

Descriptors: *Dispersants, *Biodegration, *Oil spills, *Flocculation, Surfactants, Chemical treatment, Cleanup operations, Oil.

The n-alkane fraction of Prudhoe Bay crude oil dispersed with Corexit 9527 disappeared rapidly from the water column directly beneath a seawater surface slick contained by an enclosure. Biodegradation appeared to be more important than nonbiological voltalization or photooxidation processes. Extracellular polysaccharides, synthesized by floc-forming bacteria, accumulated in the water column of the enclosures during n-alkane degradation. The study demonstrates the possibile usefulness of Corexit 9527 in accelerating the conversion of this crude oil fraction by the indigenous microflora of coastal marine waters. (Author's abstract)
W87-09512

DISTRIBUTION OF AROMATIC HYDROCARBONS IN PORT VALDEZ, ALASKA,
Rockwell International, Newbury Park, CA. Environmental Monitoring and Services Center.
I. Lysyj, G. Perkins, J. S. Farlow, and R. W. Morris.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 47-53, 2 fig, 6 tab, 7 ref.

Descriptors: *Oily water, *Distribution patterns, *Plumes, *Hydrocarbons, *Alaska, Oil pollution, Effluents, Oil, Port Valdez.

The distribution of aromatic hydrocarbons in Port Valdez, Alaska, was studied. Such compounds are present in the effluent from the ballast treatment plant located at the terminal of the TransAlaska Pipeline. Distribution of the aromatic hydrocarbons in the receiving waters was studied by collecting and analyzing samples at the boundary of the mixing zone and throughout the fjord. Vertical and horizontal transects were designed for sample collection, and a sensitive analytical procedure capable of detecting 0.1 micrograms/l of selected aromatic hydrocarbons was developed and used in

this study. It was found that the treated effluent does not mix uniformly with the receiving waters of Port Valdez during the summer period of density stratification, at which time the volume of the mixing zone is grossly underutilized and no significant amount of hydrocarbons diffuses into the upper reaches of the water column. Discharged hydrocarbons are contained within a narrow trap zone of maximum concentration which spreads out horizontally 2-3 km from the mixing zone in a thin, pancake-like shape. The vertical position of the effluent plume is dependent on prevailing water density conditions: during the early summer it is located at a depth of approximately 50m, while in late summer it is found at a depth of 65 m, and is contained within 10 m off the bottom in the area of the mixing zone. The concentrations of total volatile aromatic hydrocarbons found on the boundary of the mixing zone were as high as 120 micrograms/1. (Author's abstract)
W87-09513

BURMAH AGATE - CHRONOLOGY AND CONTAINMENT OPERATIONS,
Research Planning Inst., Inc., Columbia, SC.
T. W. Kana, E. P. Thompson, and R. Pavia.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 131-138, 7 fig, 2 tab, 4 ref, append.

Descriptors: *Oil spills, *Cleanup operations, *Oil recovery, *Booms, *Oil skimmers, *Texas, Oil slicks, Oil tankers, Oil, Burmah Agate, Mimosa.

On November 1, 1979, a collision of the Liberian registered tanker Burmah Agate and the Liberian freighter, Mimosa, produced the largest oil spill in U.S. waters for the year. The Burmah Agate, carrying almost 400,000 barrels of Nigerian crude (API No. 29.1) and a blend (API No. 39.3), settled on the bottom in 13.5 m of water approximately 7 km southeast of Galveston Entrance. The collision ruptured two starboard midship tanks resulting in explosions and fire that left 33 dead. Listing slighly to starboard with part of the deck awash, the Burmah Agate continued to burn out of control for over 2 months. Responsibility for firefighting and onshore cleanup was assumed by the ship owners. However, the U.S. Coast Guard took an active role in the containment and recovery of spilled oil at the wreck site, protection of oil-sensitive environments onshore. Booms, skimmers and skimming barriers were deployed around the ship and recovery of spilled oil began by November 9, 1979. Early recovery efforts were hampered by weather and burning slicks which destroyed booms deployed too close to the ship. However, during the succeeding month, over 6,700 barrels of oil and water emulsion were recovered from the water. Booms and skimmers were deployed in Galveston Entrance, San Luis Pass, and smaller passes to the west to minimize the potential threat of spilled oil to sensitive coastal environments. The fire burned itself out by January 8, 1980, after 250,000 barrels had either been consumed by fire or released into the environment. Over 150,000 bbl were eventually salvaged from the forward tanks before the ship was refloated and towed to Brownsville, Texas, for scrap. (Author's abstract)
W87-09519

SURVEILLANCE, TRACKING, AND MODEL CORRELATION OF THE SPILL FROM THE TANKER BURMAH AGATE,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W87-09520

SIMPLIFIED MODELS TO PREDICT THE BREAKUP OF OIL ON ROUGH SEAS,
Little (Arthur D.), Inc., Cambridge, MA.
K. S. Aravamudan, P. K. Raj, and G. Marsh.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 153-159, 4 fig, 14 ref.

Descriptors: *Oil spills, *Oil slicks, *Distribution patterns, *Wave action, Waves, Dispersion, Oil-water interface.

This study attempts to integrate existing theoretical models and experimental information on the behavior of oil spills in the ocean into a unified, sequential calculation procedure to predict the breakup of oil on rough seas. Major consideration has been given to developing the least sophisticated calculation procedures that maintain a reasonable description of the totality of the physical process. The prinicipal phenomena included in the prediction of the spill behavior are as follows: combined spreading and evaporation; slick-sea interaction and formation of oil droplets; dispersion of droplets in the water column; and finally, the formation and dispersion of slicklets caused by turbulence in the ocean. A multicomponent spreading-evaporation model was developed to predict the area, average density, and mass loss because of evaporation from the slick as a function of time for various environmental conditions. On the basis pf the well-known Pierson-Moskowitz spectrum for a fully developed sea, models were developed to predict the size of oil droplets and their distribution in the water column. A horizontal diffusion model was developed on the basis of several experimental observations to determine the dispersion of slicklets and predict the total contaminated ocean surface area as a function of time. The integrated model is computerized and has been exercised for four different types of oils, namely, light crude, heavy crude, fuel oil No. 2, and fuel oil No.6. (Author's abstract)
W87-09521

SPREADING, DISPERSION, AND EVAPORATION OF OIL SLICKS IN THE ARABIAN GULF,
University of Petroleum and Minerals, Dhahran (Saudi Arabia).
M. S. Belen, W. J. Lehr, and H. M. Cekirge.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 161-164, 4 fig, 13 ref.

Descriptors: *Oil spills, *Oil slicks, *Distribution patterns, Evaporation, Dispersants, Chemical treatment, Performace evaluation, Arabian Gulf.

This study examines the spreading, dispersion, and evaporation of oil spills subject to the environmental conditions of the Arabian Gulf. Standard approaches to oil slick transformations are modified and enhanced to better model spills in the Gulf. The results obtained, which are presented in tabular form, should provide important information in assessing the fate of any spill in the region. (Author's abstract)
W87-09522

BIOS PROJECT - FRONTIER OIL SPILL COUNTERMEASURES RESEARCH,
Environmental Protection Service, Edmonton (Alberta).
For primary bibliographic entry see Field 5G.
W87-09523

DOME'S PETROLEUM STUDY OF OIL AND GAS UNDER SEA ICE,
Dickens (D. F.) Engineering, Vancouver (British Columbia).
For primary bibliographic entry see Field 5G.
W87-09525

CONTAINMENT OF OIL SPILLED UNDER ROUGH ICE,
ARCTEC, Inc., Columbia, MD.
J. C. Cox, and L. A. Schultz.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 203-208, 5 fig, 2 tab, 1 ref.

Descriptors: *Oil spills, *Oil recovery, *Cleanup operations, *Distribution patterns, Sea ice, Performance evaluation, Oil, Oily water.

This paper outlines the results of a laboratory study of the behavior of oil spilled beneath ice having various roughness characteristics in the presence of a current. It was found convenient to categorize ice conditions and ice features by addressing the problem in terms of oil interaction with smooth ice, ice having small roughness features, and ice having large roughness features. The small or large designation is determined by whether the height of roughness elements is less than, or greater than, the equilibrium slick thickness of the oil beneath smooth ice. Further, large roughness elements can act individually, or they can act in combination, forming a cavity. In general terms, oil spilled beneath ice cover will remain stationary until the current velocity relative to the ice reaches 15 to 25 cm/sec. This holds true even for oil trapped upstream of large roughness elements. At the higher velocities, cavities have a somewhat greater oil containment capability than individual large roughness elements. The paper includes a procedure for quantitatively determining the transport or containment of oil spilled beneath ice in deep water. (Author's abstract)
W87-09526

MEREDOSIA OIL TERMINAL - THE ILLINOIS RIVER FLOODS A TANK FARM,
Coast Guard District (2nd), St. Louis, MO.
For primary bibliographic entry see Field 5G.
W87-09531

UNIQUE INLAND OIL SPILL - GLENROCK, WYOMING,
Coast Guard, Hamilton AFB, CA. Pacific Strike Team.
For primary bibliographic entry see Field 5G.
W87-09532

SPILL IMPACTS AND SHORELINE CLEANUP OPERATIONS ON ARCTIC AND SUB-ARCTIC COASTS,
Woodward-Clyde Consultants, Victoria (British Columbia).
For primary bibliographic entry see Field 5G.
W87-09538

GEOMORPHOLOGICAL ALTERATION OF A HEAVILY OILED SALTMARSH (ILE GRANDE, FRANCE) AS A RESULT OF MASSIVE CLEANUP,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
J. H. Vandermeulen, B. F. N. Long, and L. D. Ozouville.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 347-351, 8 fig, 5 ref.

Descriptors: *Oil pollution, *Geomorphology, *Environmental effects, *Oil spills, Cleanup operations, Alteration of flow, Salt marshes, Oil, Ile Grande, France.

During massive cleanup of a heavily oiled saltmarsh, much of the surface sediment was removed to a depth of about 50 cm, exposing in places the underlying granite basement. This has resulted in a marked increase in the marsh cross-sectional area, in its tidal prism, and in the current velocities through the marsh. As a result, the marsh is undergoing increased erosion and invasion of sand from offshore stocks. Observations of sand transport 1 yr after the cleanup, as well as the formation of megaripple and sheet-flow characteristics 2 yr after the cleanup, indicate an increase in current velocities from a pre-spill average of 0.5 m/sec to 1 m/s, and exceeding 1.7 m/s in the main channel of the marsh. A 2-yr study of geomorphological changes in the marsh has shown that the normal pre-spill colonization rate of the marsh (28 - 90 cm/yr) has changed to a net erosion (6.5 - 17 m/yr). Increased current velocities have resulted in erosion of the exposed marsh surfaces and undercutting of the secondary and tertiary marsh tidal channels. Residual oil, left behind from the cleanup, is being trapped under sandbars. Pockets of such oil-permeated sand deposits represent potential long-term storage reservoirs available for later release. Marsh recovery to pre-spill state depends critically on the reduction of its tidal prism and of the current flow through the marsh. Based on the depositional rates for this marsh and others, this is expected to be a very slow process, unless perhaps it is enhanced by

replanting saltmarsh vegetation in denuded areas. (See also W87-09507) (Author's abstract)
W87-09543

FATE OF THE ZOE COLOCOTRONI OIL SPILL AND ITS EFFECTS ON INFAUNAL COMMUNITIES ASSOCIATED WITH MANGROVES,
Bowdoin Coll., Brunswick, ME. Marine Research Lab.
For primary bibliographic entry see Field 5C.
W87-09544

COMPREHENSIVE MODEL FOR OIL SPILL SIMULATION,
G. M. Torgrimson.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 423-429, 7 fig, 9 ref.

Descriptors: *Oil spills, *Simulation, *Oil pollution, *Path of pollutants, *Distribution patterns, *Computer models, Environmental effects, Oil On-Scene-Spill-Model.

The On-Scene-Spill Model (OSSM) is a portable, interactive, environmental simulation system for the rapid modeling of pollutant trajectories in the marine environment. Inputs to the OSSM include the physical locations of the spill, coastal outlines, bathymetry, oceanographic and meterological observations, and other environmental data. The output from this model consists of both Calcomp and printer graphics, summaries of initialized data, and checkpoint files. The user can request detailed information about data and model parameters. Typical initialization setup time is about 3 hours. The model can be run in different modes depending on the data bases used, including a climatological mode to assess long-term transport, a tactical mode to assess short-term transport, and a receptor mode. It allows the user to utilize variable time and space scales to resolve the physical transport processes, consistent with available data. This is accomplished by the use of multiple embedded submodels in the main model. (See also W87-09507) (Author's abstract)
W87-09552

FLOW AROUND SPILL CLEANUP DEVICES,
For primary bibliographic entry see Field 5G.
W87-09561

INFLUENCE ON THE GROUNDWATER CONDITIONS IN A MULTILAYERED AQUIFER SYSTEM BY ALUM-SHALE MINING,
Loussavaara-Kirunavaara AB, Skovde (Sweden).
For primary bibliographic entry see Field 5C.
W87-09570

HYDROGEOLOGIC FACTORS THAT MAY AFFECT MINE DRAINAGE IN THE ANTHRACITE REGION OF PENNSYLVANIA, EASTERN UNITED STATES,
Geological Survey, Harrisburg, PA.
For primary bibliographic entry see Field 4C.
W87-09577

SPECIAL TECHNIQUES OF GROUND TREATMENT IN MINING WORKS (LAS TECNICAS ESPECIALES DE TRATAMIENTO DEL TERRENO EN LOS TRABAJOS DE MINERIA),
Cimentaciones Especiales, S.A. Procedimientos RODIO-Madrid-Espana.
For primary bibliographic entry see Field 4B.
W87-09598

5C. Effects Of Pollution

CARCINOGENIC EFFECTS IN A/J MICE OF PARTICULATE OF A COAL TAR PAINT USED IN POTABLE WATER SYSTEMS,
Health Effects Research Lab., Cincinnati, OH.
M. Robinson, R. D. Laurie, R. J. Bull, and J. A. Stober.
Cancer Letters CALEDQ, Vol. 34, No. 1, p 49-54, January 1987. 2 tab, 9 ref.

Descriptors: *Bioassay, *Water pollution effects, *Carcinogens, *Coal tar paints, *Potable water, *Water pollution sources, Mice, Particulate matter, Coatings, Water tanks, Mutagens, Ames test.

Coal tar paints are among the products used as inside coatings for water pipes and storage tanks to retard corrosion in potable water supply systems. Four different formulations of these paints were tested in earlier work by this laboratory in the Ames mutagenesis and the mouse skin carcinogenesis bioassays. The paint most active in these assays were then tested in a particulate form in the lung adenoma assay with A/J mice. The paint was applied to clean glass plates, cured, collected and homogenized in 2% Emulphor. Doses of this coal tar suspension were administered by gavage at 1.0, 10.0 and 55.0 mg in 0.2 ml per mouse 3X weekly for 8 weeks. The total doses of coal tar paint were 24, 240, and 1320 mg/mouse. Benzo(a)pyrene (BaP), administered in a parallel schedule to a total dose of 6 mg/mouse, served as positive control. A negative control group received an equivalent volume of 2% Emulphor. Animals were killed at 9 months of age (8 months after first dose) and lung adenomas counted. A dose-related response, in the average number of lung tumors per mouse, was observed with the coal tar particulate. There were also squamous cell tumors of the forestomach in 42% of the mice receiving 55.0 mg coal tar paint per application. (Author's abstract)
W87-08613

HYDROGEN SULFIDE POISONINGS IN HOT-SPRING RESERVOIR CLEANING: TWO CASE REPORTS,
Veterans General Hospital, Taipei (Taiwan). Dept. of Medicine.
J.-F. Deng, and S.-C. Chang.
American Journal of Industrial Medicine AJIMD8, Vol. 11, No. 4, p 447-451, April 1987. 2 fig, 2 tab, 9 ref.

Descriptors: *Water pollution effects, *Maintenance, *Hydrogen sulfide, *Toxicity, *Hot springs, *Reservoirs, Case studies, Manholes, Odors, Recreation, Safety.

The potential hazards to maintenance personnel cleaning hot-spring reservoirs are reported following two severe and unusual episodes of acute hydrogen sulfide poisoning involving seven workers. In the first episode, five victims lost consciousness immediately after climbing down a manhole to the bottom of a reservoir disregarding a strong odor of rotten eggs. One of them died immediately. Of the four who lived, three developed hemorrhagic keratoconjunctivitis and aspiration pneumonia, but no sequelae were observed 2 years later. In the second episode, two workers had been cleaning the reservoir for about 2 hours when one collapsed and his companion went to seek help. Both died of acute respiratory distress syndrome due to pulmonary edema within 12 hours. Since hot-spring bathing is a popular recreation in Taiwan, other accidents of hydrogen sulfide poisoning may have occurred but have not been reported. Such clinical information is helpful to enable regulators to initiate proper precautions to safeguard those workers involved. (Author's abstract)
W87-08614

AQUATIC TOXICOLOGY AND HAZARD ASSESSMENT: EIGHTH SYMPOSIUM.
American Society for Testing Materials, Philadelphia, PA.
For primary bibliographic entry see Field 6E.
W87-08624

SCIENTIFIC CONSIDERATIONS IN THE LEGISLATIVE ARENA,
For primary bibliographic entry see Field 6E.
W87-08625

SCIENTIFIC CONSIDERATIONS IN THE INTERNATIONAL ARENA,
Unilever Research, Bebington (England). Port Sunlight Lab.
For primary bibliographic entry see Field 6E.
W87-08626

WHAT INDUSTRY IS DOING TO PROTECT AQUATIC LIFE,
Dow Chemical Company, Midland, MI. Mammalian and Environmental Toxicology.
For primary bibliographic entry see Field 5G.
W87-08628

RESEARCH NEEDS FOR RAPID ASSESSMENTS OF CHRONIC TOXICITY,
Kentucky Univ., Lexington. Graduate Center for Toxicology.
W. J. Birge, and J. A. Black.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 51-60, 29 ref.

Descriptors: *Water pollution effects, *Toxicity, *Research priorities, *Monitoring, Aquatic life, Model studies, Fish, Lethal limit, Biological analysis, Enzymes.

Chronicity frequently is the most important and sensitive factor in determining the impact of toxicant stress on aquatic biota. However, chronic values are often unavailable or inadequate to provide decisive judgments in hazard assessment. Time and cost constraints involved in generating traditional chronic data also pose equally important problems in basic toxicological research. In assessing rapid means for estimating chronicity, attention is given to predictive models based on structure-activity relationships, extrapolations from acute toxicity data, and use of short chronic (mini-chronic) tests. High priority is placed on further development and evaluation of mini-chronic tests, which have been used successfully to characterize single compounds and complex effluents, evaluate effluent treatability, and determine the effects of point-source discharges on natural receiving waters. Methods most commonly used have involved: (1) a five to eight-day fish embryo-larval test, (2) seven-day cladoceran tests, and (3) a seven-day fathead minnow larval growth test. General research needs are summarized as follows: (1) Evaluation of short toxicity tests presently available. This should include accuracy and reproducibility of endpoint determinations and statistical correlations between mini-chronic data and results obtained using traditional chronic and embryo-larval tests. (2) Design of multiple species tests, in-stream flow through tests, and other short-term test procedures for estimating chronic effects of complex effluents and single compounds. (3) Determination of the effects of laboratory and field conditions, general water quality characteristics, and selection of animal species on results of mini-chronic tests. (4) Consideration off nonorganismal tests or mathematical models that may be used to estimate chronicity. Such research may include enzyme inhibition tests, QSAR-based modeling, and extrapolations based on acute toxicity data. (5) Investigations of the physiological and biochemical mechanisms involved in acute and chronic toxicity. Analyzing the accuracy and extrapolative value of acute, mini-chronic, and chronic tests data depends in large measure on understanding the pharmacodynamics of toxicants affecting aquatic biota. (See also W87-08624) (Author's abstract)
W87-08630

RESEARCH NEEDS IN VALIDATING AND DETERMINING THE PREDICTABILITY OF LABORATORY DATA TO THE FIELD,
Colorado State Univ., Fort Collins. Water Resources Lab.
T. P. Boyle.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 61-66, 2 tab, 22 ref.

Descriptors: *Water pollution effects, *Research priorities, *Data interpretation, *Laboratories, *Fate of pollutants, Ecological effects, Sensitivity analysis, Model studies.

Three areas of research needs are identified in translating laboratory data to the field. They are: (1) an assessment of the efficiency of existing environmental fate mathematical and physical models to simulate field conditions; (2) an evaluation of the utility of single species laboratory toxicity tests to accurately assess environmental effects of contaminants; and (3) an assessment of the relative sensitivities of ecological functional process to stress. Ideas on how to address these research needs are presented. (See also W87-08624) (Author's abstract)
W87-08631

MULTISPECIES TESTS: RESEARCH NEEDS TO ASSESS THE EFFECTS OF CHEMICALS ON AQUATIC LIFE,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 5A.
W87-08632

RESEARCH NEEDS IN DEVELOPING STRUCTURE ACTIVITY RELATIONSHIPS,
Environmental Protection Agency, Washington, DC. Office of Pesticides and Toxic Substances.
R. L. Lipnick.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 78-82, 17 ref.

Descriptors: *Research priorities, *QSAR, *Water pollution effects, Quantitative Structure Activity Relationships, *Aquatic environment, *Toxicity, Bioconcentration, Chemical analysis, Biological analysis.

A short historic overview of the development of quantitative structure activity relationships (QSARs) is presented. Applications of QSARs to problems in environmental toxicology and hazard assessment are reviewed. A number of research needs related to QSARs are identified including: (1) research to quantify the effects of metabolism on a bioconcentration QSAR model; (2) research to determine the upper boundaries of linearity for the bioconcentration QSAR for hydrophobic chemicals; (3) research to refine the understanding of the predictive limitations of the QSAR for acute toxicity of simple nonelectrolytes to aquatic organisms; (4) research to identify additional classes of nonelectrolytes that exhibit increased toxicity caused by more specific mechanisms of binding to biological receptors; and (5) research involving investigations of fundamental mechanisms of toxicity. (See also W87-08624) (Author's abstract)
W87-08633

BIOLOGICAL EFFECTS OF CONTINUOUS AND INTERMITTENT DOSING OF OUTDOOR EXPERIMENTAL STREAMS WITH CHLORPYRIFOS,
Environmental Research Lab.-Duluth, MN.
J. Eaton, J. Arthur, R. Hermanutz, R. Kiefer, and L. Mueller.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 85-118, 4 fig, 12 tab, 46 ref.

Descriptors: *Pesticides, *Water pollution effects, *Chlorpyrifos, *Limnology, *Bioassay, Insecticides, Organic compounds, Biological analysis, Invertebrates, Minnows, Bluegills, Tissue analysis, Fish physiology.

Two outdoor experimental streams fed by water pumped from the Mississippi River were dosed with the organophosphorus pesticide chlorpyrifos (the active ingredient of Dursban and Lorsban 4E insecticides) for 100 days, and the responses of individual species and communities compared to those of a control stream. Chlorpyrifos was continuously metered into one stream whereas the other received 8 biweekly additions, each lasting 24 h, at 14 times the concentration in the continuously dosed stream. Therefore, nearly equal amounts of pesticide were introduced into each stream during the experiment. The biological study area of each stream was approximately 245 m long, contained a naturally colonizing plant and invertebrate assemblage, and was stocked with fathead minnows and bluegills. Measured system characteristics included macroinvertebrate drift and riffle composition; fish survival, growth, reproduction, food habits, tissue residues, and AChE inhibition; and system functional process indicators (P/R ratios, biodegradation, nitrate and DOC concentrations, and bacterial growth and heterotrophic activity). The macroinvertebrate communities reacted similarly in the continuously and pulse-dosed streams. Crippling of fathead minnows and reversible acute toxicity symptoms (lethargy, tetany when startled) in bluegills were observed only in the pulse-dosed stream. Fish survived, reproduced, and grew equally well in all streams. There seemed to be good agreement between laboratory and field effect concentrations for fish and invertebrates. Functional process indices, with the possible exception of biodegradation, appeared unaffected and considerably less sensitive than other characteristics measured. The results of the project are discussed in relation in relation to lab to field extrapolation and the need for further testing. (See also W87-08624) (Author's abstract)
W87-08634

ACCLIMATION AS A FACTOR INFLUENCING METAL CRITERIA,
Environmental Protection Agency, Corvallis, OR.
G. A. Chapman.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 119-136, 3 fig, 2 tab, 30 ref.

Descriptors: *Acclimatization, *Heavy metals, *Water pollution effects, *Lethal limit, Tolerance, Zinc, Copper, Cadmium, Chromium, Fish physiology, Environmental effects, Speciation, Complexation.

Laboratory research, primarily with salmonid fish, has demonstrated that metal acclimation can increase metal tolerance. Although slight decreases in tolerance have been reported following acclimation, reports of approximate doublings in tolerance predominate. The magnitude of increased tolerance may be metal-specific, and available data suggest the magnitude of acquired tolerance follows the series: zinc > copper > cadmium > chromium. Tolerance appears to change within a week of major changes in acclimation concentration. The significance of acclimation-induced tolerance may be important to the survival of organisms in metal-contaminated environments, but the magnitude of the tolerance change is probably within the range of many other factors influencing the accuracy of criteria. For example, the use of mean concentrations to express cycling exposure may underestimate chronic toxicity by a factor of two. Metal speciation/complexation is probably much more important to criteria accuracy than acclimation. Another important aspect of criteria evaluation is the relative resolution of laboratory tests and field monitoring. The problem of detecting biological effects following criteria violations is discussed. (See also W87-08624) (Author's abstract)
W87-08635

NEW APPROACH FOR REGULATING IRON IN WATER QUALITY STANDARDS,
American Electric Power Service Corp., Columbus, OH. Environmental Engineering Div.
For primary bibliographic entry see Field 5G.
W87-08636

COMPARISON OF QSAR PREDICTIONS WITH FISH TOXICITY SCREENING DATA FOR 110 PHENOLS,
Environmental Protection Agency, Washington, DC. Office of Pesticides and Toxic Substances.
R. L. Lipnick, C. K. Bickings, D. E. Johnson, and D. A. Eastmond.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 153-176, 4 fig, 2 tab, 19 ref.
NIH Interagency agreement AD75F1397-0.

Descriptors: *QSAR, *Prediction, *Toxicity, *Fish, *Phenols, *Quantitative structure activity relationships, *Water pollution effects, Data interpretation, Environmental effects, Aquatic environment, Lethal limits, Chemical analysis.

A comparison was made between the predicted 96-hr guppy LC sub 50s of 110 phenols based upon QSAR equations, and the data from 936 toxicity screening tests for these chemicals. Test data on up to eight species of freshwater fishes were available per compound. Overall, the experimental toxicity data on these chemicals were consistent with the QSAR predictions. The 110 phenols occupy a considerably larger range of spanned substituent space than the QSAR training set. One compound, 4-aminophenol, exhibited lethality at test concentrations of 35 times below that predicted. The increased fish toxicity of this compound is explained in terms of a proelectrophile molecular mechanism, in which the parent compound is metabolically oxidized to a para quinoid structure. The resulting electrophilic metabolite is susceptible to attack by nucleophilic moieties present in biological macromolecules leading to covalent bond formation and inhibition of biochemical processes. (See also W87-08624) (Author's abstract)
W87-08637

FIELD CONFIRMATION OF A LABORATORY-DERIVED HAZARD ASSESSMENT OF THE ACUTE TOXICITY OF FENTHION TO PINK SHRIMP, PENAEUS DUORARUM,
Environmental Research Lab., Gulf Breeze, FL.
P. W. Borthwick, J. R. Clark, R. M. Montgomery, J. M. Patrick, and E. M. Lores.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 177-189, 1 fig, 3 tab, 18 ref.

Descriptors: *Marshes, *Limnology, *Field tests, *Hazard assessment, *Toxicity, *Water pollution effects, *Shrimp, *Fenthion, Chemical analysis, Lethal limits, Aquatic environment.

Field studies were conducted to determine if laboratory protocols accurately predict shrimp mortality under field conditions. To evaluate the applicability of laboratory data, fenthion, a mosquitocide, was applied to coastal black rush (Juncus roemerianus) marshes in several truck-mounted ultra-low volume (ULV) adulticide operations and by direct application at the larvicide rate. Caged pink shrimp (Penaeus duorarum) were deployed in floating compartmented cages and observed frequently over a 24-hr period for mortality. Water samples collected for gas chromatographic quantitation characterized the exposure concentration regime and fate of fenthion at the field sites. Field data were compared to laboratory acute toxicity data from ASTM standard practice flow-through tests. The acute flow-through 96-hr LC sub 50 of 0.11 micrograms/L was used as a conservative estimate of the expected toxicity in field exposures. An exposure profile based on measured field concentrations was used for laboratory pulse-exposure tests; fenthion was measured for 2 hr to specified maximum concentrations, then flushed with seawater to cause a 6- to 8-hr exposure, yielding a no-observed-effect concentration (NOEC) of 0.84 micrograms/L. In field tests, four ULV operations produced initial water concentrations < NOEC and no fenthion-induced shrimp mortality. However, the direct application's initial water concentrations ranged from 15 to 20 micrograms/L (>NOEC) and caused extensive mortality (90 to 100%) in the caged shrimp. Thus, field observations confirmed the hypothesis that if fenthion time-exposure concentrations were lower than the laboratory NOEC, then no mortality would occur in caged shrimp. Moreover, if initial concentrations in the field exceeded the laboratory NOEC, mortality would occur. These laboratory tests and field applications indicate that laboratory toxicity tests can predict the range of lethal and nonlethal acute field exposures to fenthion for pink shrimp when exposure regimes are similar. (See also W87-08624) (Author's abstract)
W87-08638

TIME/TOXICITY RELATIONSHIPS IN SHORT-TERM STATIC, DYNAMIC, AND PLUG-FLOW BIOASSAYS,
SRI International, Menlo Park, CA. Aquatic Toxicology Program.
H. C. Bailey, D. H. W. Liu, and H. A. Javitz.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 193-212, 4 fig, 11 tab, 10 ref. EPA Contract 68-01-4108.

Descriptors: *Toxicity, *Bioassay, *Water pollution effects, *Fish, Bluegills, Acrylonitrile, Ammonia, Chlorobenzene, Chromic acid, Copper sulfate, Ethoxyethylacetate, Methylmethacrylate, Sodium hydroxide, Sulfuric acid, Xylene, Lethal limit, Statistical studies.

In order to determine the efficacy of using data from 96-hr acute bioassays for predicting toxicity associated with shorter exposure periods, a series of static, dynamic, and plug-flow bioassays were performed using bluegill as test organisms. Test chemicals included acrylonitrile, ammonia, chlorobenzene, chromic acid, copper sulfate, 2-ethoxyethylacetate, methylmethacrylate, sodium hydroxide, sulfuric acid, and xylene. Exposure durations ranged from 1 to 96 hr. Regression techniques were used to develop time-toxicity curves to determine how well short-term toxicity could be predicted by 24 to 96 hr data. The results from these experiments indicate that data from 24 to 96-hr exposure periods have limited use in predicting toxicity associated with shorter exposure periods, depending on the desired level of precision of the estimate. In extreme cases, the estimated LC sub 50s ranged from twenty-fold below to three-fold above the observed LC sub 50 values. In most cases, however, agreement between the estimated and actual LC sub 50 values was much closer. While the usefulness of such mathematical predictors remains to be established, they could have merit in assessing the potential toxicity associated with single-event exposures such as chemical spills or runoff events. (See also W87-08624) (Author's abstract)
W87-08639

ACUTE TOXICITY OF CHLORINE ON FRESHWATER ORGANISMS: TIME-CONCENTRATION RELATIONSHIPS OF CONSTANT AND INTERMITTENT EXPOSURES,
MITRE Corp., McLean, VA.
M. P. Wang, and S. A. Hanson.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 213-232, 9 fig, 4 tab, 24 ref. EPA Contract 68-01-6403.

Descriptors: *Toxicity, *Chlorine, *Water pollution effects, *Aquatic life, *Model studies, Aquatic environment, Wastewater facilities, Mathematical analysis.

The effect of chlorine exposures on the survival of freshwater aquatic life is of major concern within many of the waterbodies in the United States. Continuous chlorine exposures are a typical result of effluent releases from wastewater treatment plants. Intermittent chlorine exposures are representative of the 'blow down' antifouling procedure used for cooling towers in power plants. Presented is the derivation and resulting mathematical expressions for the time-concentration relationship of chlorine exposure and survival of freshwater aquatic organisms. Two topics are discussed: the time-concentration toxicity relationship for constant chlorine exposures and the prediction from the constant exposure mathematical expressions of toxicity caused by intermittent exposures. An extensive literature review provided the database from which mathematical time-concentration relationships were derived for constant chlorine exposures. Relationships were analyzed for individual species. The resistance of all the different species increased significantly from a 96-hr exposure period to an 8-hr exposure period. The intermittent chlorine exposure tests differ not only in the frequency and duration of the chlorine dose but also in the geometric form of the dose application. A kinetic model, which accounted for these variabilities, was used to predict intermittent exposure mortality. The parameters of the model were obtained from the analysis of constant exposure results. In addition to predicting mortality resulting from variable exposure patterns, the kinetic model may be used to design appropriate test durations for intermittent chlorination experiments. (See W87-08624) (Author's abstract)
W87-08640

SENSITIVITY OF CHRONIC ENDPOINTS USED IN DAPHNIA MAGNA STRAUS LIFE-CYCLE TESTS,
Dow Chemical Company, Midland, MI. Mammalian and Environmental Toxicology.
F. M. Gersch, D. L. Hopkins, S. L. Applegath, C. G. Mendoza, and D. P. Milazzo.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 245-252, 5 tab, 24 ref.

Descriptors: *Reproduction, *Survival, *Daphnia, *Sensitivity analysis, *Water pollution effects, *Toxicity, Lethal limits, Chemical analysis, Boric acid, Ammonia, Triclopyr triethylamine salt, Zooplankton.

The sensitivity of three endpoints used to evaluate the chronic toxicity of boric acid, un-ionized ammonia, and triclopyr triethylamine salt (TEA salt) to Daphnia magna was examined. The endpoints examined during these studies were reproduction, growth, and survival. A 21-day static renewal toxicity test was conducted with Daphnia magna for all three test materials. The maximum acceptable toxicant concentrations (MATCs) derived from these studies were boric acid 6.4 < MATC < 13.6 mg B/L, unionized ammonia 0.42 < MATC < 0.87 mg NH3-N/L, and triclopyr TEA salt 80.7 < MATC , 149.0 mg/L. Reproduction was consistently the most sensitive endpoint in all three studies. An examination of the literature indicates that the utility and relative sensitivity of reproduction and survival as chronic endpoints have been questionable because of erratic adult survival and large amounts of reproductive variation. The data from this study show that use of well nourished and healthy test organisms reduces variability in both reproduction and survival and enhances the reliability of the daphnid chronic test. (See also W87-08624) (Author's abstract)
W87-08642

AQUATIC HAZARD ASSESSMENT: PICLORAM,
Dow Chemical Co., Midland, MI. Dept. of Health and Environmental Sciences.
M. A. Mayes, and G. R. Oliver.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 253-269, 1 fig, 3 tab, 46 ref.

Descriptors: *Aquatic environment, *Hazard assessment, *Picloram, *Water pollution effects, *Path of pollutants, Tordon, Grazon, Amdon, Herbicides, Chemical analysis, Fate of pollutants, Fish, Lethal limits, Potassium, Minnows, Trout, Daphnia, Aquatic life.

Picloram (4-amino-3,5,6-trichloropicolinic acid) exhibits herbicidal activities on broadleaf weeds and woody plants and is registered under the trademarks of TORDON, GRAZON, and AMDON herbicides. It is an organic acid (pKa = 3.2); thus at environmental pH ranges it is usually found in the ionized anionic form. Other physicochemical characteristics of picloram are water solubility 430 mg/L and vapor pressure 6.16 times 10 to the minus 7th power mm mercury at 35 C. The rate of dissipation of picloram in soil is dependent on the application rate, soil type, and climate. Picloram is classified as having moderate mobility in soil; however, the runoff potential of picloram is normally limited to less than 5% of the applied chemical removed from the site in runoff waters. Picloram is relatively nontoxic to freshwater fishes, with acute LC sub 50 values for technical acid ranging from 4.3 mg/L for lake trout to 55.3 mg/L for fathead minnows. Freshwater invertebrates show similar susceptibility to technical picloram with acute LC sub 50 values ranging from 27 mg/L for Gammarus lacustris Sars to 68.3 mg/L for Daphnia magna Straus. The most sensitive marine invertebrates tested is the eastern oyster with 18 < EC sub 50 mg/L when exposed to a potassium salt formulation of picloram. Because of its relatively low toxicity to aquatic organisms and low potential for substantial quantities to enter the aquatic environment, picloram is not expected to present a hazard to the aquatic environment. (See also W87-08624) (Author's abstract)
W87-08643

EFFECTS OF TRIETHYLENE GLYCOL ON MYSIDOPSIS BAHIA (CRUSTACEA: MYSIDACEA) AND MENIDIA PENINSULAE (PISCES: ATHERINIDAE),
University of West Florida, Pensacola. Dept. of Biology.
R. M. Montgomery, J. Forester, and C. N. D'Asaro.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 270-276, 3 tab, 11 ref.

Descriptors: *Triethylene glycol, *Mysidopsis, *Menidia, *Crustaceans, *Water pollution effects, Toxicity, Lethal limits, Mysids, Silversides, Aquatic environment, Fish.

Chronic effects of triethylene glycol (TEG), a chemical frequently used as a carrier-solvent in toxicity tests, were investigated in a 23-day life-cycle toxicity test with a mysid (Mysidopsis bahia) and in a 28-day early life-stage toxicity test with the tidewater silverside (Menidia peninsulae). Test organisms were exposed to the same range of concentrations: seawater control, 3.2, 10, 32, 100, 320, and 1000 mg/L. Effects, if any, were measured by survival and reproduction for the mysids and survival and growth for the silversides. It is concluded that no direct adverse effect can be expected as a result of using TEG at concentrations as high as 100,000 times (mysids) and 360 times (tidewater silversides) those recommended in ASTM drafts of standard practices (< or = 0.01 microL/L in Mysidopsis bahia life-cycle tests and < or = 0.01 microL/L in tests with early life-stages of Menidia peninsulae) and that either a seawater or a TEG control may not be necessary. (See also W87-08624) (Author's abstract)
W87-08644

INTERLABORATORY COMPARISON OF THE ASTM BIOCONCENTRATION TEST METHOD USING THE EASTERN OYSTER,
Environmental Protection Agency, Narragansett, RI.
For primary bibliographic entry see Field 5A.
W87-08645

HARMONIZATION OF BIOLOGICAL TESTING METHODOLOGY: A PERFORMANCE-BASED APPROACH,
Environmental Monitoring Systems Lab., Las Vegas, NV.
For primary bibliographic entry see Field 5A.
W87-08646

TOXICITY OF AQUEOUS EXTRACTS OF NATURAL AND SYNTHETIC OILS TO THREE SPECIES OF LEMNA,
Murray State Univ., KY. Dept. of Biological Sciences.
J. M. King, and K. S. Coley.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 302-309, 2 fig, 38 ref. EPA Contract R809946.

Descriptors: *Toxicity, *Water pollution effects, *Oils, *Duckweed, Bioassay, Algae, Aquatic plants.

This study was designed to determine the acute toxicity of natural and synthetic oils to three spe-

cies of Lemna. The major objectives were to determine if members of this genus can be efficiently used as bioassay organisms and if their growth responses to these oils were similar to those reported for algae. The experimental approach involved exposure of L. gibba, L. minor, and L. perpusilla under standard laboratory conditions to two crude oils, a fuel oil, and two coal-liquefaction products. Growth was monitored as changes in frond numbers. The results indicate that the coal-liquefaction products had a greater acute toxicity than the natural oils to the three species, which were similar to results obtained with algae. Also, the three species proved to be efficient and effective bioassay organisms. (See also W87-08624) (Author's abstract)
W87-08647

COMPARISON OF TECHNIQUES FOR EVALUATING THE EFFECT OF CADMIUM ON PSEUDOMAS FLUORESCENS,
Toronto Univ. (Ontario). Dept. of Microbiology.
P. L. Seyfried, and C. B. L. Horgan.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 310-320, 1 fig, 39 ref.

Descriptors: *Water pollution effects, *Comparison studies, *Cadmium, *Pseudomonas, Bacteria, Toxicity, Adenosine triphosphate, Bioassay, Microscopic analysis, Formazan.

Three techniques were compared in a study of the effect of cadmium on an aquatic strain of Pseudomonas fluorescens. The methods used were: (1) direct microscopic counts using epifluorescence and formazan detection, (2) determination of colony-forming units, and (3) determination of intracellular adenosine triphosphate (ATP) using a firefly luciferase bioluminescent assay. Results of the plate count and ATP determinations demonstrated that P. fluorescens was stressed after exposure to 10-, 25-, 50-, and 100-ppm cadmium. The organisms recovered following treatment; however, only the ATP bioassay data indicated that there might be bacterial recovery at 12-hr after the addition of 100-ppm cadmium. The acridine orange 2-(p-iodophpenyl)-3-(p-nitrophenyl)-5-phenyl tetrazolium chlorine (INT) formazan reduction technique did not produce results that could be readily interpreted. The bacteria tended to clump together, and cells that had been exposed to 100-ppm cadmium generally did not fluoresce. In addition, it was not possible to detect formazan deposits in any of the cadmium-treated cells. Compared to the plate count procedure and the acridine orange INT-formazan reduction technique, the intracellular ATP assay appeared to be more accurate method of determining the viability of P. fluorescens cells following cadmium treatment. (See also W87-08624) (Author's abstract)
W87-08648

MEASURING FISH LENGTHS FROM INSTANT PHOTOGRAPHS USING A DIGITIZING TABLET AND MINICOMPUTER,
Lilly Research Labs., Greenfield, IN.
For primary bibliographic entry see Field 7B.
W87-08649

ADVANTAGES OF USING REGRESSION ANALYSIS TO CALCULATE RESULTS OF CHRONIC TOXICITY TESTS,
Environmental Research Lab.-Duluth, MN.
C. E. Stephan, and J. W. Rogers.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 328-338, 30 ref.

Descriptors: *Data interpretation, *Water pollution effects, *Toxicity, *Regression analysis, Statistical studies, Biological magnification, Chronicity.

Although results of most chronic toxicity tests have been calculated using hypothesis testing to detect statistically significant differences from the control, calculation of results using regression analysis offers several major advantages. By deriving an equation for the concentration-effect relationship, regression analysis allows estimation of the concentration corresponding to a specified amount of an adverse effect or estimation of the amount of effect corresponding to a specified concentration. In addition, whereas the number of replicates, agreement between replicates, and selection of alpha (the acceptable level of Type 1 error) have no impact on the estimate of the endpoint concentration calculated using regression analysis, they have a great impact on decisions concerning whether tested concentrations caused statistically significant differences. Further, use of regression analysis emphasizes the necessity of considering the biological importance of the adverse effects observed in toxicity tests. By using hypothesis testing, aquatic toxicologists have been able to avoid this difficult, important question by presenting results in terms of a variable 'statistically significant difference'. (See also W87-08624) (Author's abstract)
W87-08650

EFFECTS OF AN ACIDIC RIVER, CAUSED BY ACIDIC RAIN, ON WEIGHT GAIN, STEROIDOGENESIS, AND REPRODUCTION IN THE ATLANTIC SALMON (SALMO SALAR),
Halifax Fisheries Research Lab. (Nova Scotia). Fisheries and Environmental Sciences Div.
H. C. Freeman, and G. B. Sangalang.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 339-349, 6 fig, 2 tab, 28 ref.

Descriptors: *Water pollution effects, *Acid rain, *Salmon, *Nova Scotia, *Rivers, *Limnology, *Westfield River, Growth, Fish physiology, Toxicity, Hydrogen ion concentration, Mortality, Sublethal effects.

In 1981, wild male Atlantic salmon (Salmo salar) captured in the low pH (pH 4.7) Westfield River, Nova Scotia, Canada, had lower plasma androgen levels at sexual maturity compared to levels in wild male salmon sampled in the nearby less acidic (pH 5.6) Medway River. In 1982, Atlantic salmon held in cages and fed daily in the Westfield River (pH range 5.1 to 5.3) during the last three months of their sexual maturation cycle gained less weight, produced smaller eggs, and had abnormal steroid hormone metabolism compared to similar fish held in the less acidic Medway River (pH range 5.4 to 6.1). The mortality of eggs taken and fertilized from salmon held in the Westfield River exceeded 90% while the mortality of eggs from the Medway River salmon was 59%. (See also W87-08624) (Author's abstract)
W87-08651

USEFULNESS OF THE LIPID INDEX FOR BIOACCUMULATION STUDIES WITH DAPHNIA MAGNA,
Battelle Pacific Northwest Labs., Richland, WA.
D. D. Dauble, D. C. Klopfer, D. W. Carlile, and R. W. Hanf.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 350-358, 2 fig, 2 tab, 19 ref. DOE Contract DE-AC06-76RLO 1830.

Descriptors: *Path of pollutants, *Water pollution effects, *Lipids, *Bioaccumulation, *Daphnia, Toxicity, Hazard assessment, Bioassay, Aquatic environment, Quinoline, Tissue analysis.

Bioaccumulation studies with Daphnia magna have become an important tool for hazard evaluation of potentially toxic materials released to aquatic environments. Despite widespread use of this test organism, little attention has been paid to influence of stored lipids on uptake of xenobiotics. The principles of zooplankton population dynamics in the limnological literature were drawn upon, to define experimental parameters for bioconcentration testing of organic compounds. Adult test populations were initially starved and monitored for lipid content and brood production. Mean lipid index values declined at 72 hr to less than 50% of those observed at 24 hr. The number of hatched young peaked at 48 hr and was inversely related to lipid storage and ovary production. In a separate experiment, uptake kinetics of 14-C labelled quinoline were compared between two daphnid test groups with mean lipid scores of 5.4 and 2.8, respectively. Total radioactivity was significantly higher for the high lipid group at 8 hr, and the coefficient of variation was lower. Estimated bioconcentration factors adjusted to dry weight were similar. Studies indicated that lipid reserves of daphnid test populations can be routinely monitored as an indicator of stress in the laboratory. Bioaccumulation tests should be limited to less than 24 hr to avoid depletion of lipid stores, which may cause increased variation in tissue concentration over time. (See also W87-08624) (Author's abstract)
W87-08652

EFFECTS OF SUSPENDED VOLCANIC ASH AND THERMAL SHOCK ON SUSCEPTIBILITY OF JUVENILE SALMONIDS TO DISEASE,
Battelle Pacific Northwest Labs., Richland, WA. Environmental Sciences Dept.
T. M. Poston, D. A. Neitzel, C. S. Abernethy, and D. W. Carlile.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 359-374, 5 fig, 2 tab, 21 ref, append. DOE Contract DE-AC06-76RLO 1830.

Descriptors: *Water pollution effects, *Thermal stress, *Volcanic ash, *Salmon, Toxicity, Bacteria, Flexibacter, Sublethal effects, Suspended solids, Fish.

The relationship between the incidence of disease in fish and stress is well recognized as a limiting factor in aquaculture and hatchery operations. Crowding, temperature, and accumulation of wastes are major contributing factors to hatchery fish disease. The susceptibility of salmonids to the fish pathogen, Flexibacter columnaris, was used to assess sublethal stress following exposures to two environmental stressors, thermal shock, and suspended volcanic ash. Juvenile rainbow trout (Salmo gairdneri) were more susceptible to disease following exposure to 0.3- and 11.5-g/L suspended volcanic ash. The response was dose dependent. Exposure of juvenile chinook salmon (Oncorhynchus tshawytscha) to thermal shock did not result in increased susceptibility to disease. In several tests, thermally exposed fish were less susceptible to disease than control fish. (See also W87-08624) (Lantz-PTT)
W87-08653

APPROPRIATE DURATIONS AND MEASURES FOR CERIODAPHNIA TOXICITY TESTS,
Minnesota Univ., Minneapolis. Dept. of Ecology and Behavioral Biology.
D. C. McNaught, and D. I. Mount.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 375-381, 2 fig, 3 tab, 2 ref. EPA Cooperative Grant 810775.

Descriptors: *Water pollution effects, *Ceriodaphnia, *Toxicity, Ecosystem, Water temperature, Neonates, Statistical studies, Bioassay.

The objectives of this analysis of the Mount-Norberg Ceriodaphnia toxicity test were to improve its application to specific ecosystems and to shorten the duration required to obtain significant results. The three-brood seven-day toxicity test using Ceriodaphnia grown at 25 C became a 28-day test at 18 C. Using typical ecosystem temperature is an important aspect of this test when applied to specific locations. Generally Ceriodaphnia can be grown at temperatures of 12 to 25 C; too few neonates were produced at 6 C for useful test results. The synchronous release of neonates by parthenogenic females may be used in determining when to sample offspring and thus reduce the cost of testing complex effluents. The intrinsic growth rate r of these animals may be used instead of their net reproductive rate R sub o to provide answers in a shorter time, with smaller coefficients of variation. (See also W87-08624) (Author's abstract)

W87-08654

RAPID AQUATIC TOXICITY ASSAY USING INCORPORATION OF TRITIATED-THYMIDINE INTO SEA URCHIN, ARBACIA PUNCTULATA, EMBRYO: EVALUATION OF TOXICANT EXPOSURE PROCEDURES,
JRB Associates, Narragansett, RI. Marine Services Branch.
D. E. Nacci, and E. Jackim.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 382-394, 2 fig, 2 tab, 32 ref.

Descriptors: *Embryos, *Isotope studies, *Tritium, *Aquatic environment, *Water pollution effects, *Toxicity, *Bioassay, *Echinoderms, Growth, Lethal limit, Minnows, Daphnia.

Toxicity of substances in seawater was measured using growth inhibition of embryonic sea urchins during a short period after fertilization. Growth of Arbacia punctulata embryos was monitored by incorporation of tritium-labeled thymidine, a nucleoside incorporated into newly synthesized deoxyribonucleic acid (DNA). Sensitivity and ranking ability of this rapid Arbacia embryo test were judged by comparison of toxicity values for several organic industrial chemicals using this test and two standard acute aquatic toxicity tests. Median effective toxicity values (EC sub 50 values) for early embryos compared favorably to median lethal values (LC sub 50 values) obtained in standard acute toxicity tests using Pimephales promelas (fathead minnow) and Daphnia magna (water flea). Presented is a comparison of toxicant exposure procedures using the Arabacia embryo thymidine incorporation test. Toxicant exposure began before, at the time of, or after fertilization and continued for 4 hr following fertilization. In addition to the eight organic chemicals with embryotoxic potentials (tumor promoters and teratogens) were tested to determine differential sensitivities of exposed life-stages: unfertilized egg, fertilization, and early embryo. EC sub 50 values for any one substance were not significantly changed by exposure modification. Toxicity values for exposures that included fertilization as well as early embryo growth were at least as sensitive as post-fertilization exposure values for all compounds tested except one. Because of technical ease and potential sensitivity, toxicant exposure that includes fertilization as well as early embryo growth (but not unfertilized egg exposure) is recommended for future testing. (See also W87-08624) (Author's abstract)
W87-08655

ACUTE AND CHRONIC TOXICITY TO THE FATHEAD MINNOW, PIMEPHALES PROMELAS, OF EFFLUENTS FROM A TREATMENT PLANT RECEIVING DYE AND PIGMENT PROCESSING WASTEWATER,
Environmental Research Lab.-Duluth, Cincinnati, OH. Newtown Fish Toxicology Station.
Q. H. Pickering, G. M. Shaul, and K. A. Dostal.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 395-406, 4 tab, 22 ref.

Descriptors: *Water pollution effects, *Toxicity, *Minnows, *Industrial wastewater, *Dyes, Activated sludge, Activated carbon, Lethal limits, Larvae, Sensitivity analysis, Effluents.

Ninety-six hour, static acute, and continuous-flow early life-stage (ELS) chronic toxicity tests, using the fathead minnow (Pimephales promelas), were conducted to evaluate the toxicity of effluents from a pilot scale activated sludge (AS) treatment system receiving dye and pigment wastewater. In the first test with a powdered activated carbon (PAC) dosage of 1800 mg/L of influent, survival was the most sensitive measure of effect in the ELS test. The highest effluent concentration tested (10%) was lethal to the embryos and larvae. No adverse effect on survival or growth was observed at lower effluent concentrations (5.0 to 0.63%). The maximum acceptable toxicant (effluent) concentration (MATC) was between 10 and 5%. Ten 96-hr median lethal concentration (LC sub 50) values from static acute tests ranged from 12.9 to greater than 80%. In the second test at a PAC dosage of 1000 mg/L of influent, growth was the most sensitive measure of effect in the ELS test. Larval growth was significantly reduced at the highest effluent concentration tested (20%). The MATC was between 20 and 10%. Seven 96-hr LC sub 50 from static acute tests ranged from 28.3 to greater than 80%. The effluent from the treatment system receiving the higher PAC dosage of 1800 mg/L was more toxic than the effluent from the treatment system receiving the lower PAC dosage of 1000 mg/L. However, the influent to the treatment system receiving the higher level of PAC also was more acutely toxic. (See also W87-08624) (Author's abstract)
W87-08656

BIOCONCENTRATION OF FOUR CHLORINATED DIOXINS BY RAINBOW TROUT AND FATHEAD MINNOWS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5B.
W87-08659

ENVIRONMENTAL EXPOSURE FROM CHEMICALS.
For primary bibliographic entry see Field 5B.
W87-08670

ENVIRONMENTAL SYSTEMS ANALYSIS: AN OVERVIEW,
Dow Chemical Co., Midland, MI. Agricultural Products Dept.
For primary bibliographic entry see Field 5B.
W87-08671

ENVIRONMENTAL EXPOSURE FROM CHEMICALS.
For primary bibliographic entry see Field 5B.
W87-08675

POSSIBLE INFLUENCE OF THE COMPONENTS OF THE SOIL AND LITHOSPHERE ON THE DEVELOPMENT AND GROWTH OF NEOPLASMS,
European Institute of Ecology and Cancer, Brussels (Belgium).
For primary bibliographic entry see Field 2K.
W87-08693

EPIDEMIOLOGY OF DENTAL CARIES IN RELATION TO ENVIRONMENTAL TRACE ELEMENTS,
Bradford Univ., (England). School of Environmental Science.
B. E. Davies, and R. J. Anderson.
Experientia EXPEAM, Vol. 43, No. 1, p 87-92, January 1987. 59 ref.

Descriptors: *Water quality effects, *Epidemiology, *Caries, *Water supply, *Fluorides, *Dental health, *Trace elements, *Molybdenum, *Selenium, Geochemistry, Bacteria.

This paper reviews the influence of the geochemical environment on the epidemiology of human dental caries. The best documented association is that between water borne fluoride and reduced caries prevalence. The influence of fluoride was first reported during the early decades of this century in Colorado, USA, and led to the fluoridation of some public water supplies in several countries. In all cases, fluoridation has been followed significant improvements in dental health and no adverse affects in general health. Other trace elements in food and water have now been linked with dental caries. Molybdenum has been associated with reduced caries prevalence dissolution of the enamel surface by the products of bacterial activity. It is possible that the incorporation of trace metals into the apatite microcrystals of enamels may alter their physical properties especially solubility, and hence their susceptibility to degradation. (Author's abstract)
W87-08694

OUTBREAK OF LEGIONNAIRES' DISEASE IN GLASGOW ROYAL INFIRMARY: MICROBIOLOGICAL ASPECTS,
Glasgow Univ. (Scotland). Dept. of Bacteriology.
M. C. Timbury, J.R. Donaldson, A. C. McCartney, R. J. Fallon, and J. D. Sleigh.
Journal of Hygiene JOHYAY, Vol 97, No. 3, p 393-403, December 1986. 3 fig, 3 tab, 18 ref.

Descriptors: *Water pollution effects, *Public health, *Legionnaires' disease, *Microbilogical studies, *Ventilation, *Air conditioning, Cooling towers.

The bacteriological investigation of an outbreak of Legionnaires' in Glasgow Royal Infirmary is described. Most of the patients had been treated in high dependency areas on two floors of the hospital supplied by the same two air-conditioned ventilation systems. The source of the infection was traced to contamination of a cooling tower from which a plume of spray discharged into the intake vents of the two ventilation systems. Rubber grommets within the cooling tower probably provided a nidus of infection there. The control and management of the outbreak are discussed: a policy of frankness about the course and progress of the investigations was adopted and helped to allay anxiety on the part of both staff and media. (Author's abstract)
W87-08703

GROWTH AND DEVELOPMENT OF RANA ARVALIS IN CONDITIONS IMITATING OIL CONTAMINATION,
O. A. Pyastolova, and M. N. Danilova.
Soviet Journal of Ecology SJECAH, Vol. 17, No. 4, p 209-214, March 1987. 5 tab, 28 ref. Translated from Ekologiya, No. 4, p 27-34, July-August 1986.

Descriptors: *Water pollution effects, *Rana, *Oil pollution, *Frogs, Aquatic habitats, Oil spills, Growth, Ontogenesis, Survival.

The influence of different concentrations of crude oil on embryonic and larval development of the sharp-snouted frog was investigated. An ecological evaluation of the consequences of oil contamination of the aquatic environment and various types of bottoms is given. Even the lowest concentrations (0.05 ml/liter) of oil exert an unfavorable influence on early stages of ontogenesis of Rana arvalis Nilss., reflected in reduced survival, change in tempos of growth, development, and fatness, and the appearance of anomalies and deformities. (Author's abstract)
W87-08713

USE OF BULLFROGS (RANA CATESBEIANA) AS BIOLOGICAL MARKERS FOR 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN CONTAMINATION IN THE ENVIRONMENT,
National Center for Toxicological Research, Jefferson, AR. Div. of Chemistry.
For primary bibliographic entry see Field 5A.
W87-08733

BENTHIC MACROINVERTEBRATES OF THE MEUSE RIVER IN BELGIUM: A REVIEW OF FIVE YEARS OF RESEARCH (1980-1984) (LES MACROINVERTEBRES BENTHIQUES DE LA MEUSE BELGE: BILAN DE CINQ ANNEES DE RECHERCHES (1980 A 1984),
Facultes Universitaires Notre-Dame de la Paix, Namur (Belgique). Unite d'Ecologie des Eaux Douces.
D. M. Meurisse-Genin, A. Reydams-Detollenaere, P. Stroot, and J.-C. Micha.
Archiv fuer Hydrobiologie AHYBA4, Vol. 109, No. 1, p 67-88, March 1987. 1 fig, 2 tab, 33 ref.

Descriptors: *Water pollution effects, *Limnology, *Meuse River, *Macroinvertebrates, *Reviews, Belgium, Taxonomy, Species composition, Rivers.

Macroinvertebrates were studied from 1980 to 1984 in various parts of the Belgian course of the

Meuse River. The results of these studies are gathered and discussed. Almost 50 years after the previous faunal list a list involves 110 taxa belonging to 66 families. The diversity of the benthic fauna at the 17 sampling sites and the relative abundance of the major groups point out a considerable impoverishment of the fauna in the lower part of the river, below its confluence with the polluted Sambre River and below Liege's industrial zone, while upstream benthic communities appear to have remained healthy and rather little disturbed. (Alexander-PTT)
W87-08765

MODEL FOR PREDICTING THE INFLUENCE OF MOISTURE STRESS ON CROP LOSSES CAUSED BY OZONE,
Portland Univ., Oregon. Dept. of Physical and Life Sciences.
For primary bibliographic entry see Field 2I.
W87-08783

IMPACT OF SIMULATED ACIDIC PRECIPITATION ON QUANTITY AND QUALITY OF A FIELD GROWN POTATO CROP,
Pennsylvania State Univ., University Park. Dept. of Plant Pathology.
E. J. Pell, C. J. Arny, and N. S. Pearson.
Environmental and Experimental Botany EEBODM, Vol. 27, No. 1, p 7-14, January 1987. 1 fig, 7 tab, 18 ref.

Descriptors: *Acid rain, *Air pollution effects, *Water pollution effects, *Precipitation, *Potatoes, *Crop yield, *Simulated rainfall, Rainfall field tests, hydrogen ion concentration.

A system was developed to deliver rain to field grown plants and used to study the impact of acidic rain on a potato crop. In 1983 and 1984, Norchip potato plants were grown under standard field practices. Plots, 2.2 sq m in area, received 0.5 cm of simulated rain three times per week throughout the growing season. Rain treatments had a pH of 2.8, 3.8, 4.6, or 5.6. There was also a 'no rain' treatment for which plants received an equivalent volume of water at the soil surface. Each treatment was replicated eight times. Two 9x26.4 m greenhouses mounted on rails covered the plots when simulated rain was being delivered and during ambient rain events. A drip irrigation system provided supplemental water to ensure adequate soil moisture. At harvest, tuber yield and quality were determined. There were no detectable effects of acidity on tuber weight, number, total solids, total glycoalkaloid or sugar content. (Author's abstract)
W87-08789

EFFECT OF FERTILIZATION WITH MUNICIPAL SLUDGE ON THE GLUTATHIONE, POLYAMINE, AND CADMIUM CONTENT OF COLE CROPS AND ASSOCIATED LOOPERS (TRICHOPLUSIA NI),
New York State Coll. of Agriculture and Life Sciences, Ithaca. Boyce Thompson Institute for Plant Research.
P. R. Hughes, L. H. Weinstein, S. H. Wettlaufer, J. J. Chiment, and G. J. Doss.
Journal of Agricultural and Food Chemistry JAFCAU, Vol. 35, No. 1, p 50-54, January-February 1987. 6 tab, 51 ref.

Descriptors: *Water pollution effects, *Waste disposal, *Soil amendments, *Fertilization, *Municipal wastewater, *Nitrogen compounds, *Glutathione, *Cadmium, *Vegetable crops, *Bioaccumulation, *Cabbage loopers, Fertilizers, Wastewater, Heavy metals, Accumulation, Sludge disposal, Land disposal, Stress, Leaves, Toxicity, Insects, Growth, Food chains, Birds, Biological magnification.

Cabbage and collards grown in pots in soil amended by municipal sludge accumulated cadmium. Glutathione content of both young and old leaves was significantly higher in the sludge-grown vegetables than in the corresponding control plants, probably in response to stress factors imposed by the sludge amendment. Putrescine, spermidine, and spermine, measured only in the collards, also increased, possibly by induction due to cadmium accumulation or to general metal stress. Cabbage loopers foraging on the sludge-grown plants assimilated and concentrated cadmium from the contaminated foliage. Putrescine, spermidine, and spermine also increased in the loopers associated with the collards whereas glutathione did not. The insects grew larger but developed more slowly on the sludge-grown collards than on the corresponding control plants. Possible accumulation of cadmium in insects by insect-consuming birds is discussed. (Author's abstract)
W87-08835

HEAVY METAL POLLUTION OF THE MID-CANAL OF KANDY: AN ENVIRONMENTAL CASE STUDY FROM SRI LANKA,
Peradeniya Univ. (Sri Lanka). Dept. of Geology.
C. B. Dissanayake, J. M. Niwas, and S. V. R. Weerasooriya.
Environmental Research ENVRAL, Vol. 42, No. 1, p 24-35, February 1987. 9 fig, 1 tab, 18 ref.

Descriptors: *Heavy metals, *Water pollution effects, *Sri Lanka, *Canals, *Wastewater, *Case studies, *Water analysis, *Path of pollutants, *Drinking water, Chemical analysis, Lead, Cadmium, Vanadium, Iron, Water pollution sources, Wells, Water quality, Developing countries, Municipal wastewater, Wastes, Domestic wastes, Farm wastes.

An 8-km effluent canal running through Kandy, the second largest city in Sri Lanka, collects massive quantities of domestic, municipal, and agricultural waste products. In this study, 37 samples of canal water and 13 samples from nearby drinking water wells were analyzed for various heavy metals using standard methods for the examination of water and wastewater as prescribed by the American Public Health Association. The following average values for the canal water were recorded: Pb, 269 micrograms/l; Cd, 138 micrograms/l; V, 18 micrograms/l; total Fe, 4 mg/l. These values indicate the relative levels of metal input from the effluent sources of Kandy. The analysis of water from drinking wells near the canal showed high concentrations of metals, in some cases exceeding the maximum tolerance limits recommended by WHO. It is concluded that the environmental impact of polluted city canals running through densely populated cities, particularly in developing countries, can assume serious proportions. (Author's abstract)
W87-08840

EMBRYOTOXICITY, TERATOGENICITY, AND ARYL HYDROCARBON HYDROXYLASE ACTIVITY IN FORSTER'S TERNS ON GREEN BAY, LAKE MICHIGAN,
D. J. Hoffman, B. A. Rattner, L. Sileo, D. Docherty, and T. J. Kubiak.
Environmental Research ENVRAL, Vol. 42, No. 1, p 176-184, February 1987. 2 tab, 46 ref.

Descriptors: *Toxicity, *Hydroxylases, *Enzymes, *Terns, *Water birds, *Lake Michigan, *Water pollution effects, *Polychlorinated biphenyls, *Dioxins, Birds, Water pollution, Hydrocarbons, Chlorinated hydrocarbons, Bays, Environment, Estuarine environment, Eggs, Incubation, Hatching, Mortality, Liver, Tissue analysis, Growth.

The endangered Forster's tern (Sterna forsteri) in Green Bay, WI suffers from reproductive problems, including congenital malformations and poor hatching success. Twenty Forster's tern eggs were collected from separate nests at (1) a natural colony with documented reproductive problems situated at Green Bay, Lake Michigan, and (2) an inland colony at Lake Poygan (control) where reproduction was documented as normal. Eggs from the two locations were placed in the same laboratory incubator and candled throughout incubation. Hatching success of eggs from Green Bay was 52% of that for controls. Several early embryonic deaths occurred, with mortality usually occurring close to the time of hatching. Liver microsomal aryl hydrocarbon hydroxylase activity was elevated approximately threefold in Green Bay hatchlings compared to controls. Green Bay terns that hatched weighed less than controls, had an increased liver to body weight ratio, and a shorter femur length. Two Green Bay embryos that failed to hatch had anomalies: one with a crossed beak and one with poor ossification of the foot. One Green Bay hatchling had an abnormally ossified ilium. These effects were observed in eggs in which there were measurable levels of aryl hydrocarbon hydroxylase inducers including polychlorinated biphenyls and polychlorinated dibenzo-p-dioxins. (Author's abstract)
W87-08841

EFFECT OF INGESTED BENZO(A)PYRENE AND CADMIUM ON TISSUE ACCUMULATION, HYDROXYLASE ACTIVITY, AND INTESTINAL MORPHOLOGY OF THE BLACK SEA BASS, CENTROPRISTIS STRIATA,
National Marine Fisheries Service, Charleston, SC. Charleston Lab.
P. H. Fair, and A. R. Fortner.
Environmental Research ENVRAL, Vol. 42, No. 1, p 185-195, February 1987. 3 fig, 3 tab, 29 ref.

Descriptors: *Benzo(a)pyrene, *Cadmium, *Bioaccumulation, *Histology, *Path of pollutants, *Bass, *Enzymes, *Fish physiology, *Water pollution effects, Fish, Metabolism, Animal physiology, Tissue analysis, Toxicity, Hydrocarbons, Shrimp, Crustaceans, Muscle, Liver, Biological magnification, Ecological effects, Ecosystem effects, Food chains, Metals, Heavy Metals, Isotope studies.

Black sea bass (Centropristis striata) were fed shrimp containing 200 ppb (C14)benzo(a)pyrene in the presence and absence of 10 ppm cadmium for 10 days. Concentrations of cadmium in muscle tissue were significantly higher when both cadmium and benzo(a)pyrene were ingested simultaneously by the fish. Results indicate that selected tissue concentrations of total benzo(a)pyrene compounds (parent and metabolites) were not affected by the presence of cadmium. The bile contained the majority of benzo(a)pyrene in all treatments. Ingestion of both contaminants had no effect on hepatic benzo(a)pyrene hydroxylase activity. Histological evidence demonstrated the presence of subcellular inclusions in the intestinal columnar cells, and the combined effects of both contaminants appeared greater than either alone. It is concluded that interactions among organic and inorganic contaminants and the subsequent effect on accumulations in food fish and shellfish may have important implications for human health. Contaminants such as Cd seldom exist in the marine environment without the presence of other pollutants such as petroleum hydrocarbons. Predictions of human health risks from fish consumption based on estimates of Cd accumulations alone might underestimate potential risk from Cd. (Author's abstract)
W87-08842

IN VITRO CYTOTOXICITY OF ORGANIC POLLUTANTS TO BLUEGILL SUNFISH (BF-2) CELLS,
Rockefeller Univ., New York. Laboratory Animal Research Center.
H. Babich, and E. Borenfreund.
Environmental Research ENVRAL, Vol. 42, No. 1, p 229-237, February 1987. 5 fig, 2 tab, 27 ref.

Descriptors: *Toxicity, *Water pollution effects, *Organic compounds, *Sunfish, *Tissue culture, *Histology, *Phenols, *Methylmercury, *Toluene, Fish, Tissue analysis, Culturing techniques, Assay, Hydrocarbons, Chlorinated hydrocarbons, Mortality, Chemical properties, Dyes, Industrial wastes.

BF-2 cells, an established cell line derived from bluegill sunfish, were exposed to 18 organic toxicants; cytotoxicity was assayed by the neutral red technique. Based on the concentration of toxicant that reduced lysosomal uptake of neutral red by 50%, the order of cytotoxicity was methyl mercury > pentachlorophenol > 2,3,5,6-tetrachlorophenol > 2,3,5-trichlorophenol > 2,3-dinitrotoluene > 2,4,6-trichlorophenol > 2,4-dichlorophenol > 2,4-dichlorotoluene > 6-chloro-3-hydroxytoluene > o-chlorotoluene > 4-chlorophenol > 2-chlorophenol, 2,4-dimethylphenol > 2,4-dinitrophenol > 4-nitrophenol > 3-methylphenol >

phenol > toluene. With the exception of 2,4-dinitrophenol, there was a good correlation between the in vitro cytotoxicity of the test agents and their reported in vivo waterborne acute toxicity. The potencies of the substituted phenolics and chlorinated toluenes as determined by the in vitro cytotoxicity assay correlated strongly with their log octanol/water partition coefficients (log P), although the toxicity of 2,3-dinitrotoluene in vitro, and apparently also in vivo, was not a function of its log P value. (Author's abstract)
W87-08843

AGE-DEPENDENT LUNG DOSES FROM INGESTED 222RN IN DRINKING WATER,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. J. Crawford-Brown.
Health Physics HLTPAO, Vol. 52, No. 2, p 149-156, February 1987. 4 fig, 2 tab, 27 ref.

Descriptors: *Population exposure, *Water pollution effects, *Path of pollutants, *Radon radioisotopes, *Drinking water, *Water quality standards, *Lung, Risks, Administrative agencies, Standards, Legal aspects, Regulations, Administrative regulations, Tissue analysis.

The U.S. Environmental Protection Agency is currently considering regulatory standards limiting the concentration of 222Rn in public drinking water supplies. As part of this effort, a criteria document has been prepared detailing the health risks expected from the presence of 222Rn in water used in homes. This report examines the dose equivalent delivered to lung tissue following direct ingestion of 222Rn in water. Irradiation from both in-situ decay of 222Rn in lung tissue and the decay of 222Rn in lung air passages following exhalation are examined and results presented for ages from neonate through adult. Assuming ingestion of 200 ml of unheated water per day at all ages and a concentration of 1.0 Bq/l, the annual dose equivalent to the basal cells of the fifth generation from ingestion of 222Rn at 0, 2, 5, and 10 and adult ages is 0.0000054 Sv, 0.0000016 Sv, 9.7 x 10 to the minus 7th power Sv, 5.9 x 10 to the minus 7th power Sv, and 2.7 x 10 to the minus 7th power Sv if an adult value of 2.7 x 10 to the minus 9th power Sv/Bq for in situ decay is assumed. These values are all well below those from inhalation, indicating that the risk of lung cancer from inhalation of airborne progeny following emanation of 222Rn from water into home air is significantly greater than the risk from both irradiation pathways considered in ingestion at all ages. (Author's abstract)
W87-08844

LEAD NITRATE INDUCED CHANGES IN THE THYROID PHYSIOLOGY OF THE CATFISH CLARIAS BATRACHUS (L),
Banaras Hindu Univ., Varanasi (India). Dept. of Zoology.
S. R. Katti, and A. G. Sathyanesan.
Ecotoxicology and Environmental Safety EESADV, Vol. 13, No. 1, p 1-6, February 1987. 4 fig, 1 tab, 16 ref.

Descriptors: *Lead, *Nitrates, *Fish physiology, *Thyroid, *Catfish, *Water pollution effects, *Toxicity, *Heavy metals, Fish, Animal physiology, Histology, Tissue analysis, Radioisotopes, Iodine radioisotopes, Bioaccumulation, Iodine, Halogens.

Chronic exposure of the catfish Clarias batrachus to a sublethal dose of 5 ppm lead nitrate for 150 days was found to impair thyroid function. Histological observations revealed hypertrophy, increased cell height, vacuolation, and reduction of colloid. The thyrotrophs of the pituitary also exhibited hypertrophy, although radioiodine (I131) uptake was significantly lowered. Fish exposed to 5, 10, and 25 ppm of lead nitrate for 7 days also exhibited significant, dose-dependent reduction in I131 uptake. These findings suggest that lead nitrate impairs thyroid function involving the hypothalamohypophysiothyroid axis. (Author's abstract)
W87-08850

IMPACT OF PESTICIDES ON LIPID METABOLISM IN THE FRESHWATER CATFISH, CLARIAS BATRACHUS, DURING THE VITELLOGENIC PHASE OF ITS ANNUAL REPRODUCTIVE CYCLE,
Banaras Hindu Univ., Varanasi (India). Dept. of Zoology.
B. Lal, and T. P. Singh.
Ecotoxicology and Environmental Safety EESADV, Vol. 13, No. 1, p 13-23, February 1987. 4 tab, 26 ref. Grant-in-Aid HCS/DST/928/80. ICAR-PL-480 Project IN-ARS-213.

Descriptors: *Pesticide toxicity, *Catfish, *Fish physiology, *Water pollution effects, *Lipids, *Metabolism, *Lindane, *Malathion, Pesticides, Toxicity, Organophosphorus compounds, Organophosphorus pesticides, Hydrocarbons, Chlorinated hydrocarbons, Liver, Fatty acids, Blood, Muscle, Tissue analysis.

Specimens of the freshwater catfish Clarias batrachus were exposed to safe and sublethal concentrations of gamma-BHC (2 and 8 ppm) and malathion (1 and 4 ppm) for 4 weeks during the vitellogenic phase of their annual reproductive cycle. The effects on total lipids and its fractions, (free fatty acids, monoglycerides, diglycerides, triglycerides, phospholipids, free cholesterol, and esterified cholesterol) were studied in liver, plasma, gonads, and muscle. Except for elevated liver lipid in the male in response to malathion, no significant change in total lipid could be observed following pesticide exposure. However, various lipid fractions responded differently to two concentrations of the pesticides. Both pesticides affected the metabolism of both nonpolar and less polar lipids. Malathion inhibited mobilization of hepatic phospholipid to gonads, but not its hepatic biosynthesis, whereas gamma-BHC reduced its synthesis in the liver as well. These pesticides seemed to restrict the conversion of esterified cholesterol into free cholesterol without affecting the biosynthesis of cholesterol as such. Esterification of free fatty acids to acyl glycerides and their mobilization from liver to gonads seemed to be restricted as a result of the pesticides. (Author's abstract)
W87-08851

XENOBIOTIC-METABOLIZING ENZYME SYSTEMS IN TEST FISH: I. COMPARATIVE STUDIES OF LIVER MICROSOMAL MONOOXYGENASES,
Istituto Superiore di Sanita, Rome (Italy). Lab. di Tossicologia Comparata ed Ecotossicologia.
E. Funari, A. Zoppini, A. Verdina, G. De Angelis, and L. Vittozzi.
Ecotoxicology and Environmental Safety EESADV, Vol. 13, No. 1, p 24-31, February 1987. 1 fig, 3 tab, 20 ref.

Descriptors: *Fish physiology, *Enzymes, *Metabolism, *Toxicology, *Bioassay, *Liver, *Water pollution effects, Animal physiology, Fate of Fish, Guppies, Killifish, Trout, Assay, Bluegills, Carp, Organic compounds.

Monooxygenase activities assayed in guppy (Poecilia reticulata) and red killifish (Oryzias latipes) were found to be 7-10 times higher than those measured in trout (Salmo gairdneri), carp (Cyprinus carpio), and golden orfe (Leuciscus idus). Cytochrome P-450 was 3 times higher in the former fish than in all the other species. Zebra fish (Brachydanio rerio) 7-ethoxycoumarin O-deethylase and bluegill (Lepomis macrochirus) ethylmorphine N-demethylase (EMND) were not greatly different from those of the former group. Alpha-naphthoflavone (NF) and methyrapone (MET) exerted qualitatively different actions on benzo(a)pyrene hydroxylase of guppy, trout, and bluegill liver. Both chemicals enhanced the bluegill activity and inhibited that of trout. Guppy liver enzyme was inhibited by MET and activated by NF. EMND activity was inhibited by each compound in three species. The relevance of all these data to the European Economic Community ecotoxicity tests is discussed. (Author's abstract)
W87-08852

LIMITS OF BIOACCUMULATION OF ORGANIC PIGMENTS IN FISH: THEIR RELATION TO THE PARTITION COEFFICIENT AND THE SOLUBILITY IN WATER AND OCTANOL,
Ecological and Toxicological Association of the Dyestuffs Manufacturing Industry, Basel (Switzerland).
For primary bibliographic entry see Field 5B.
W87-08853

LONG-TERM EFFECTS OF BLEACHED KRAFT MILL EFFLUENTS ON CARBOHYDRATE METABOLISM AND HEPATIC XENOBIOTIC BIOTRANSFORMATION ENZYMES IN FISH,
Goeteborg Univ. (Sweden). Dept. of Zoophysiology.
T. Andersson, B.-E. Bengtsson, L. Forlin, J. Hardig, and A. Larsson.
Ecotoxicology and Environmental Safety EESADV, Vol. 13, No. 1, p 53-60, February 1987. 1 fig, 3 tab, 25 ref.

Descriptors: *Water pollution effects, *Kraft mills, *Pulp wastes, *Carbohydrates, *Metabolism, *Liver, *Enzymes, *Fish physiology, *Biotransformation, Pulp and paper industry, Wastewater, Industrial wastewater, Fish, Sculpin, Muscle, Pathology, Animal pathology, Toxicity, Bioassay.

Fourhorn sculpin (Myoxocephalus quadricornis) were exposed for 5-9 months in the laboratory to wastewater from pine and birch lines from a bleached kraft pulp plant. The bleached kraft mill effluents (BKME) affected both the carbohydrate metabolism and the xenobiotic metabolism. Elevated muscle glycogen content in fish exposed to effluent from the pine pulp line suggests a metabolic imbalance. Liver enlargement and strong elevation of the hepatic cytochrome P-450-dependent ethoxyresorufin-O-deethylase activity after exposure to the bleached pine pulp effluents indicate the presence of cytochrome P-450-inducing agents in the BKME. Results also demonstrate that many physiological test parameters may be useful indicators of sublethal disturbances in fish exposed to BKME. (Author's abstract)
W87-08854

QUANTITATIVE AND QUALITATIVE ASPECTS OF FISH CROP IN RELATION TO ENVIRONMENTAL QUALITY,
Academia Sinica, Luojiashan (China). Institute of Hydrobiology.
J. K. Liu, and X. He.
Ecotoxicology and Environmental Safety EESADV, Vol. 13, No. 1, p 61-75, February 1987. 6 fig, 3 tab, 36 ref.

Descriptors: *Environmental quality, *Aquaculture, *China, *Water pollution effects, *Fisheries, *Fish management, *Toxicity, *Fish populations, Lake fisheries, Stream fisheries, Reservoir fisheries, Estuarine fisheries, Fish, Ecosystems, Aquatic ecosystems, Ecological effects, Populations, Environmental protection, Water quality, Water quality management, Developing countries.

The effects of environmental quality on the quantitative and qualitative aspects of fish crop are reviewed in fisheries in rivers, lakes, reservoirs, and coastal waters ranging from the temperate zone to subtropical areas in mainland China. The mechanism of these effects is discussed, and the insidiousness of long-term exposure to low-concentration pollutants to fish stock is stressed. Most available information on the effects of pollution on fish has been derived from laboratory studies in which the antagonistic or synergistic action between multiple pollutants was scarcely taken into consideration. It is concluded that the results of laboratory experiments should be extrapolated to the natural environment with caution. It is suggested that surveys and tests on the relation between environmental quality and fish be made in natural waters as well as in the laboratory, and the effects be elucidated at the individual, population, and ecosystem levels. (Author's abstract)
W87-08855

INFLUENCE OF CADMIUM EXPOSURE ON SELECTED HEMATOLOGICAL PARAM-

ETERS IN FRESHWATER TELEOST, NOTEMIGONUS CRYSOLEUCAS,
Northeast Louisiana Univ., Monroe. School of Pharmacy.
W. H. Benson, K. N. Baer, R. A. Stackhouse, and C. F. Watson.
Ecotoxicology and Environmental Safety EESADV, Vol. 13, No. 1, p 92-96, February 1987. 4 fig, 16 ref.

Descriptors: *Cadmium, *Blood, *Notemigonus, *Fish physiology, *Glucose, *Enzymes, *Water pollution effects, *Bioindicators, Heavy metals, Population exposure, Pollutant identification, Bioassay, Assay, Indicators, Monitoring, Fish.

An investigation was undertaken to evaluate the use of selected hematological parameters in aquatic organisms as diagnostic tests for cadmium exposure. Exposure of the freshwater teleost Notemigonus crysoleucas to cadmium resulted in a 96-hr LC50 value of 3.15 mg Cd/l. The influence of cadmium on selected hematological parameters was examined following 96 hr of exposure to 0, 1.35, and 2.40 mg Cd/l. Cadmium exposure produced significant alterations ($P < 0.05$) in the levels of glucose, aspartate aminotransaminase, and alanine aminotransaminase. Hematocrit was not altered by exposure to cadmium. It is concluded that glucose and transaminases may be useful as diagnostic tests for cadmium exposure in aquatic organisms. (Author's abstract)
W87-08857

PESTICIDE-INDUCED CHANGES IN PERIPHERAL THYROID HORMONE LEVELS DURING DIFFERENT REPRODUCTIVE PHASES IN HETEROPNEUSTES FOSSILIS,
Banaras Hindu Univ., Varanasi (India). Dept. of Zoology.
A. K. Yadav, and T. P. Singh.
Ecotoxicology and Environmental Safety EESADV, Vol. 13, No. 1, p 97-103, February 1987. 2 fig, 1 tab, 20 ref. ICAR Grant FG-IN-620; DOE Grant J-13013/18/83-EN-I.

Descriptors: *Pesticide toxicity, *Water pollution effects, *Thyroid hormones, *Fish physiology, *Catfish, *Lindane, *Malathion, Animal physiology, Fish, Toxicology, Pesticides, Organophosphorus pesticides, Insecticides, Hydrocarbons, Chlorinated hydrocarbons, Blood, Tissue analysis, Metabolism, Excretion, Path of pollutants.

Effects of the insecticides gamma-BHC and malathion were evaluated on plasma triiodothyronine (T sub 3) and thyroxine (T sub 4) levels in the freshwater catfish Heteropneustes fossilis during its annual reproductive cycle. After four weeks' exposure of gamma-BHC (8 and 16 ppm) and malathion (10 and 20 ppm), the effects on plasma T sub 3, T sub 4, and T sub 3/T sub 4 ratio varied during different reproductive phases. Malathion appeared to have a stimulatory effect, while gamma-BHC appeared to have an inhibitory effect on extrathyroidal conversion of T sub 4 to T sub 3. Changes in levels of various thyroid hormones during different reproductive phases occurred probably due either to inhibited (in response to gamma-BHC) or to stimulated (in response to malathion) extrathyroidal T sub 4 monodeiodination and their altered excretion or consumption rate. (Author's abstract)
W87-08858

COMPARATIVE METABOLISM OF FENITROTHION IN AQUATIC ORGANISMS: I. METABOLISM IN THE EURYHALINE FISH, ORYZIAS LATIPES AND MUGIL CEPHALUS,
Sumitomo Chemical Co., Ltd., Takarazuka (Japan). Takarazuka Research Center.
For primary bibliographic entry see Field 5B.
W87-08859

COMPARATIVE METABOLISM OF FENITROTHION IN AQUATIC ORGANISMS: II. METABOLISM IN THE FRESHWATER SNAILS, CIPANGOPALUDINA JAPONICA AND PHYSA ACUTA,
Sumitomo Chemical Co., Ltd., Takarazuka (Japan). Takarazuka Research Center.
For primary bibliographic entry see Field 5B.
W87-08860

COMPARATIVE METABOLISM OF FENITROTHION IN AQUATIC ORGANISMS: III. METABOLISM IN THE CRUSTACEANS, DAPHNIA PULEX AND PALAEMON PAUCIDENS,
Sumitomo Chemical Co., Ltd., Takarazuka (Japan). Takarazuka Research Center.
For primary bibliographic entry see Field 5B.
W87-08861

EFFECTS OF DISTILLERY WASTE ON THE PERFORMANCE OF CICER ARIETINUM L.,
Gorakhpur Univ. (India). Dept. of Botany.
N. Srivastava, and R. Sahai.
Environmental Pollution, Vol. 43, No. 2, p 91-102, February 1987. 7 tab, 21 ref.

Descriptors: *Impaired water use, *Distillery waste, *Cicer, *Water pollution effects, *Phytotoxicity, *Germination, *Growth, *Waste disposal, Wastes, Industrial wastes, Toxicity, Seeds, Productivity, Primary productivity, Pigments, Protein, Biomass, Seedlings, Roots, Leaves, Fertilization, Fertilizers, India, Chlorophyll, Biological oxygen demand, Salinity, Carbon dioxide.

The impact of distillery effluent in various concentrations (1, 2.5, 5, 10, 25, 50, 75, and 100%) was investigated on the seed germination, Speed of Germination Index, growth behavior, leaf area, biomass, net primary productivity, pigment content, reproductive capacity, seed output, seed weight, seed density, and the seed protein content of Cicer arietinum L. plants. The percentage and speed of germination of seeds were increasingly retarded with increase in effluent concentration, and at 100% concentration there was no germination. The seedlings exhibited maximum shoot length at 5% concentration and maximum root length at 2.5% concentration. The values of root and shoot lengths, leaf area, biomass, net primary productivity, pigment content, reproductive capacity, seed output, seed weight, seed density, and seed protein content in pot plants exhibited a gradual increase from the control up to 5% concentration and decreases at higher concentrations. It is suggested that the very high BOD load and the presence of excessive concentrations of soluble salts could be responsible for the toxicity of the effluent. The effluent at up to 5% concentration was, however, beneficial for the overall growth parameters studied, and can thus be used as a liquid fertilizer. (Author's abstract)
W87-08873

EFFECT OF POLLUTED AND LEACHED SNOW MELT WATERS ON THE SOIL BACTERIAL COMMUNITY--QUANTITATIVE RESPONSE,
University of East Anglia, Norwich (England). School of Environmental Sciences.
I. P. Thompson, I. L. Blackwood, and T. D. Davies.
Environmental Pollution, Vol. 43, No. 2, p 143-154, February 1987. 6 tab, 40 ref.

Descriptors: *Acid rain, *Acid snow, *Snowmelt, *Water pollution effects, *Leaching, *Soil bacteria, *Ecological effects, *Population density, *Acidic waters, *Nitrogen cycle, Bacteria, Scotland, Heterotrophic bacteria, Culturing techniques, Snow cover, Snowpack, Soil profiles, Soil horizons, Acidity, Chemical properties, Statistical analysis.

The effect of polluted snowmelt waters on the number of soil bacteria was determined using soil cores extracted from an upland catchment in the Cairngorm Mountains (Scotland). Total numbers of viable heterotrophic bacteria and bacterial denitrifiers were determined using plate and MPN counts. Separate soil cores were treated with simulated melt waters representative of the composition of the first melt fraction from either polluted or leached snowpacks. The number of bacteria in the Ah soil horizon treated with polluted snow melt (PSM) water decreased significantly 28-fold, but increased by 11-fold in the BC horizon. Denitrifier numbers decreased by 8-fold in the Ah horizon, but increased by more than 2-fold lower down the profile. Overall, the bacterial community exposed to simulated leached snow melt (LSM) waters showed little change in the Ah horizon. In the BC horizon, total viable bacterial numbers decreased 20-fold, but denitrifiers numbers were unaffected. (Author's abstract)
W87-08874

USE OF THE POCKETBOOK MUSSEL, LAMPSILIS VENTRICOSA, FOR MONITORING HEAVY METAL POLLUTION IN AN OZARK STREAM,
Missouri Department of Conservation, Columbia.
For primary bibliographic entry see Field 5A.
W87-08875

ACUTE TOXICITY OF BRESTAN AND FENTIN ACETATE ON SOME FRESHWATER ORGANISMS,
L. Cotta-Ramusino, and A. Doci.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 4, p 647-652, April 1987. 3 fig, 4 tab, 5 ref.

Descriptors: *Pesticide toxicity, *Brestan, *Fentin acetate, *Metal organic pesticides, *Isopods, *Aquatic insects, *Water pollution effects, Toxicity, Pesticides, Tin, Heavy metals, Herbicides.

The acute toxicity of the herbicide stannic triphenylacetate (Brestan) was tested on aquatic organisms and compared with pure fentin acetate. Organisms used were the isopod Asellus aquaticus, larval Chironomus riparius, and the cyprinid Carassius auratus. Mortality rates (TLm) for 24 and 48 hrs and the safe dilution (D) calculated for each species are as follows: (1) for C. auratus, TLm 24 h = 0.676 mg/l, TLm 48 h = 0.62 mg/l, D = 0.16 mg/l; (2) for A. aquaticus, TLm 24 h = 3-5 mg/l, TLm 48 h = 1.1 mg/l, D = 0.02-0.04 mg/l; and (3) for C. riparius, TLm 24 h = 0.07 mg/l, TLm 48 h = 0.05 mg/l, D = 0.008 mg/l. (Doria-PTT)
W87-08876

TOXICITY OF PICLORAM (4-AMINO-3,5,6-TRICHLOROPICOLINIC ACID) TO LIFE STAGES OF THE RAINBOW TROUT,
Dow Chemical Co., Midland, MI. Mammalian and Environmental Toxicology.
M. A. Mayes, D. L. Hopkins, and D. C. Dill.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 4, p 653-660, April 1987. 3 tab, 12 ref.

Descriptors: *Picloram, *Pesticide toxicity, *Herbicides, *Trout, *Growth stages, *Water pollution effects, Pesticides, Toxicity, Fish, Larval growth stage, Eggs, Fish eggs, Survival, Mortality, Morbidity.

The toxicity of the pyridine herbicide picloram to fishes was determined by conducting an embryo-larval test with rainbow trout obtained from a trout farm in Red Bluff, CA. Estimated 96-h and 192-h LC50 values and 95% confidence intervals were 15.6 (14.3-17.0) and 14.0 (12.5-15.8) mg/l, respectively. Partial mortality occurred at 16.5 mg/l during the first 96 h and at 10.9 mg/l after 192 h of exposure. Sublethal effects such as surface breathing, lack of schooling behavior, and loss of equilibrium were observed at 10.9 mg/l and higher. Dissolved oxygen remained < 80% saturation; the pH and temperature ranged between pH 7.8-8.2 and 11.8-12.5 C, respectively. It is concluded that picloram does not constitute an acute or chronic hazard to aquatic life under present use guidelines. (Doria-PTT)
W87-08877

EFFECTS OF LOWERED DISSOLVED OXYGEN CONCENTRATION ON THE TOXICITY OF 1,2,4-TRICHLOROBENZENE TO FATHEAD MINNOWS,
Environmental Research Lab.-Duluth, MN.
A. R. Carlson.
Bulletin of Environmental Contamination and

Toxicology BECTA6, Vol. 38, No. 4, p 667-673, April 1987. 1 tab, 11 ref.

Descriptors: *Dissolved oxygen, *Toxicity, *Water pollution effects, *Minnows, *Trichlorobenzene, *Chlorinated hydrocarbons, *Fish, Oxygen, Hydrocarbons, Growth stages, Juvenile growth stage, Larval growth stage, Tissue analysis, Hatching, Biological magnification, Incubation, Survival, Statistical analysis, Growth, Accumulation, Bioaccumulation.

The effects of dissolved oxygen (DO) concentrations were determined on the toxicity of 1,2,4-trichlorobenzene (1,2,4-TCB) to fathead minnows (Pimephales promelas) exposed during the embryonic-to-larval-juvenile development stage. Analyses were conducted by gas chromatography. For fish chronically exposed to the mean 1,2,4-TCB concentration of 920 micrograms/l at 8.1 mg/l DO, mean survival was 37.5% less and mean weight was 28.7% less than compared to the 8.1 mg/l DO control. At the comparable toxicant concentration at 5.6 mg/l DO, the mean percentage survival and mean weight of test fish were not statistically different (P = 0.95) compared to the 5.6 mg/l DO control. At the comparable mean, 1,2,4-TCB concentration of 920 micrograms/l at 4.5 mg/l DO, effects on survival and growth were more marked; mean survival was reduced by 88.5%, and mean weight by 60.5% compared to the 4.5 mg/l DO control. No effects of 1,2,4-TCB on survival, growth, and bioconcentration were observed at mean concentrations of 500 micrograms/l or lower, and no direct effects of lowered DO concentrations were evident. DO concentrations had no significant effect on 1,2,4-TCB uptake by the fish. (Doria-PTT)
W87-08879

ACUTE TOXICITY OF EMULSIFIABLE CONCENTRATIONS OF THREE INSECTICIDES COMMONLY FOUND IN NONPOINT SOURCE RUNOFF INTO ESTUARINE WATERS TO THE MUMMICHOG, FUNDULUS HETEROCLITUS,
South Carolina State Dept. of Health and Environmental Control, Columbia.
A. H. Trim.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 4, p 681-686, April 1987. 13 ref.

Descriptors: *Toxicity, *Insecticides, *Agricultural runoff, *Nonpoint pollution sources, *Estuarine environment, *Fish, *Water pollution effects, Environment, Malathion, Pesticides, Organic pesticides, Organophosphate pesticides, Phosphothioate pesticides, Chromatography, Gas chromatography, Mortality.

The acute toxicity of three agricultural insecticides (malathion, endosulfan, and fenvalerate) and an insecticide mixture (endosulfan-fenvalerate) were evaluated using adult mummichog (Fundulus heteroclitus) obtained from an estuary south of Charleston, SC. Endosulfan was the most toxic based on a 96-h LC50 of 1.15 micrograms/l. Fenvalerate was second most toxic (96-h LC50 = 1.84 micrograms/l). The mixture was third, with a 96-h LC50 of 3.06 micrograms/l. Malathion was least toxic (96-h LC50 = 22.51 micrograms/l). The U. S. Fish and Wildlife Acute Toxicity Ratings Scale was applied to the results; malathion is rated as 'extremely toxic,' with the other formulations tested being 'supertoxic.' It is suggested that ecological field sampling should be added to an integrated laboratory and field toxicity testing approach to properly assess the ecological effects of pesticides in the coastal zone. (Doria-PTT)
W87-08881

CADMIUM CONTAMINATION IN AMERICAN LOBSTER, HOMARUS AMERICANUS, NEAR A COASTAL LEAD SMELTER: USE OF MULTIPLE LINEAR REGRESSION FOR MANAGEMENT,
Department of Fisheries and Oceans, Halifax (Nova Scotia). Fisheries and Environmental Sciences.
J. F. Uthe, D. P. Scott, and C. L. Chou.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 4, p 687-694, April 1987. 2 fig, 3 tab, 8 ref.

Descriptors: *Cadmium, *Lobsters, *Monitoring, *Bioaccumulation, *Tissue analysis, *Marine environment, *Water pollution effects, *Fisheries, *Shellfish farming, Regression analysis, Crustaceans, Heavy metals, New Brunswick, Canada, Mineral industry, Water pollution sources, Accumulation, Spectroscopy, Atomic absorption spectroscopy, Statistical analysis, Sampling, Environment, Aquaculture.

Monitoring data on cadmium levels in lobsters, obtained between 1981 and 1985 at Belledune Harbor, New Brunswick, were analyzed in order to predict the years in which certain changes to the lobster fishery management plan might be implemented. Cadmium measurements were carried out by atomic absorption spectrophotometry using a graphite tube furnace and the method of standard additions where needed. Contamination is very high, with mean Cd concentrations in lobster digestive gland of 160 mg/kg wet weight at a site near the effluent pipeline of a lead smelter. Improved effluent treatment since 1980 has reduced aqueous Cd discharges by more than 95%. Between 1981 and 1985, Cd concentrations in digestive gland decreased 63.3-68.7%; concentrations in cooked meat have decreased 55.6-64.3%. A statistical analysis was based upon stepwise, backward, multiple linear regression, and mean Cd levels in digestive gland and cooked meat are predicted for 1986. It is suggested that the controlled fishery zone established in 1980 may safely be eliminated in 1987, and that the harbor should be re-opened to normal fishery in 1989. It is further concluded that the use of a rational sampling plan coupled with an intensive statistical investigation provided results with a high degree of confidence using a relatively small number of samples from each site. (Doria-PTT)
W87-08882

CADMIUM AND LEAD IN LAKE ONTARIO SALMONIDS,
Rochester Univ. Medical Center, NY. Dept. of Biophysics.
For primary bibliographic entry see Field 2H.
W87-08883

HEXAVALENT CHROMIUM EFFECTS ON CARBON ASSIMILATION IN SELENASTRUM CAPRICORNUTUM,
North Texas State Univ., Denton. Inst. of Applied Sciences.
D. A. Pillard, P. M. Rocchio, K. M. Cassidy, S. M. Stewart, and B. D. Vance.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 4, p 715-721, April 1987. 4 fig, 15 ref.

Descriptors: *Chromium, *Carbon, *Bioaccumulation, *Selenastrum, *Photosynthesis, *Toxicity, *Bioindicators, *Bioassay, Accumulation, Chlorophyta, Indicators, Plant physiology, Algae, Productivity, Primary productivity, Radioisotopes, Carbon radioisotopes, Radioactivity techniques, Light intensity, Respiration, Carbon dioxide, Assay.

The potential effects of hexavalent chromium on Selenastrum capricornutum were evaluated via photosynthetic response. Productivity was determined using the 14C method. Concentrations of cadmium (0.0, 0.02, 0.04, 0.06, 0.08, and 0.10 mg/l) were added to sets of light and dark bottles which were then injected with 14C-labeled NaHCO3 and incubated. Primary productivity remained relatively constant through time except for an insignificant decrease at 0.02 mg/l. The decline was due to both a decrease in carbon uptake in the light bottles and a sharp increase in the dark bottles. Carbon uptake in the dark bottles was significantly different among treatments. It was apparent that a stimulatory effect (hormesis) by chromium was occurring in the dark bottles. It is concluded that hexavalent chromium appears to act primarily on processes occurring in the absence of light in the Chlorophyta. Respiration is stimulated, while dark carbon uptake may be suppressed. Low concentrations of chromium (<0.1 mg/l) may have a stimulatory effect, improving apparent carbon uptake. However, this is critically dependent upon initial cell density; very dense cultures may exhibit no effects. Therefore, initial cell counts and other test conditions must be standardized when short-term 14C productivity is used for toxicant evaluation. (Doria-PTT)
W87-08886

CORRELATION BETWEEN HEAVY METAL ACUTE TOXICITY VALUES IN DAPHNIA MAGNA AND FISH,
Industrial Toxicology Research Centre, Lucknow (India).
For primary bibliographic entry see Field 5A.
W87-08887

DYNAMICS OF NITROGEN AND CARBON IN SOIL DURING PAPERMILL SLUDGE DECOMPOSITION,
Maine Univ. at Orono. Dept. of Plant and Soil Sciences.
For primary bibliographic entry see Field 5E.
W87-08891

EFFECT OF IRRIGATION ON PERSISTENT TOXICITY OF INSECTICIDES APPLIED AS GRANULES TO SOIL TO BROWN PLANT HOPPER AND RICE SWARMING CATERPILLAR,
Kerala Agricultural Univ., Trivandrum (India).
For primary bibliographic entry see Field 5B.
W87-08897

IMPACT-SENSITIVENESS OF SOIL ORIBATID SPECIES TO THE WASTE WATER FROM A COAL DISTILLATION PLANT,
Calcutta Univ. (India). Dept. of Life Science.
For primary bibliographic entry see Field 5A.
W87-08898

EFFECT OF MOSQUITO KILLER INSECTICIDES ON FRESHWATER MUSSELS,
Balaton Limnological Research Inst., Tihany (Hungary).
I. Varanka.
Comparative Biochemistry and Physiology (C), Vol. 86, No. 1, p 157-162, January 1987. 2 fig, 3 tab, 28 ref.

Descriptors: *Limnology, *Mosquitoes, *Pesticide toxicity, *Mussels, *Aquatic environment, *Insecticides, *Water pollution effects, Aquatic insects, Environment, Hardness, Chemical properties, Salinity, Mortality, Behavior, Animal behavior, Mollusks, Malathion, Pesticides, Organic pesticides, Organophosphorus pesticides, Toxicity, Animal physiology.

The effects of 4 insecticides (Fyfanon, K-Orthrin, Unitox 7, and Unitox 20) was investigated on the freshwater mussels Anodonta cygnea, A. anatina, and Unio pictorum. The studies were performed in hard water. LC50 values for 24, 48, 72, and 96 h and for 7 days were determined with a static test at 22 C. All 3 mussels proved to be extremely tolerant to the insecticides tested. However, at a concentration of 0.1 microgram/l, all 4 insecticides affected the periodic activity of U. pictorum. In A. anatina, 3 of them (Fyfanon, K-Orthrin, and Unitox 7) and in A. cygnea 2 of them (K-Orthrin and Unitox 7) evoked alterations. This concentration is lower by 3 to 5 orders of magnitude than those of the 96-h LC50 values. (Author's abstract)
W87-08908

CONTAMINATION OF FISH FROM THE FRENCH ZONE OF LAKE LEMAN BY ORGANOCHLORINE COMPOUNDS BETWEEN 1973 AND 1981 (CONTAMINATION DES POISSONS DU SECTEUR FRANCAIS DU LAC LEMAN, PAR LES COMPOSES ORGANOCHLORES ENTRE 1973 ET 1981),
Ministere de l'Agriculture, Paris (France). Laboratoire Central d'Hygiene Alimentaire.

For primary bibliographic entry see Field 2H.
W87-08909

FATE OF 14C-LINDANE IN A RICE-FISH MODEL ECOSYSTEM,
Middle Eastern Regional Radioisotope Centre for the Arab Countries, Cairo (Egypt).
For primary bibliographic entry see Field 5B.
W87-08915

SWINE MANURE AND LAGOON EFFLUENT APPLIED TO A TEMPERATE FORAGE MIXTURE: I. PERSISTENCE, YIELD, QUALITY, AND ELEMENTAL REMOVAL,
Agricultural Research Service, Raleigh, NC. Dept. of Crop Science and Animal Science.
J. C. Burns, P. W. Westerman, L. D. King, M. R. Overcash, and G. A. Cummings.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 2, p 99-105, April-June 1987. 7 tab, 34 ref.

Descriptors: *Animal wastes, *Lagoon effluents, *Forages, *Waste disposal, *Land disposal, *Nutrients, *Water pollution effects, *Crop yield, Swine, Manure, Groundwater, Grasses.

Swine (Sus scrofa domesticus) waste can be a nutrient source for crops when applied as a manure slurry or lagoon effluent. Limited land area for disposal may result in high application rates. Yet rates must be controlled to ensure stand persistence if perennial crops are grown and if groundwater quality (NO3 concentrations) are to be considered. Also, safe concentration of elements in the resulting forage must be assured if used for animal feed. A 4-yr study was conducted to determine the effect of applying swine waste as manure slurry or lagoon effluent on persistence of a temperate forage mixture of predominantly tall fescue (Festuca arundinacea Schreb.). Treatments were: a commercial N-P-K fertilizer (F), consisting of 201 kg/N/ha/yr (67 kg/ha in three applications) and 34 and 65 kg/ha of P and K, respectively; 670 kg of N/ha/yr as a swine manure slurry (M); and supplying approximately 600 (E1) and 1200 (E2) kg of N/ha from swine lagoon effluent. Subtropical grasses invaded all treatments by the third year but the E2 treatment had greatest infestation averaging 53% of the dry matter and tall fescue averaging only 39%. Dry matter yields were similar between F and M treatments averaging 7750 kg/ha/yr while applying N as effluent (E1) increased yields 3430 kg/ha above M. Doubling the N loading rate (E2 vs. E1) did not increase yields ($P < or = 0.05$). Concentrations of the 11 elements analyzed (N, P, K, Ca, Mg, Cl, Mn, Cu, Zn, Fe, and Na) showed a treatment x year interaction. Forage Zn was consistently increased by M treatment compared with F or E1 treatments and forage Cu was elevated by M treatment the last 2 yr of the study. In vitro dry matter disappearance was similar (670-685 g/kg) among all treatments, but forage NO3-N concentration from E1 and E2 treatments, and after the second year for the M treatment, was considered unsafe for ruminants (> 700 mg NO3-N/kg). The M, E1, and E2 treatments added large quantities of elements (N, P, K, Ca, Na, and Cl) that were not removed in the forage. (See also W87-08920) (Author's abstract)
W87-08919

SWINE MANURE AND LAGOON EFFLUENT APPLIED TO A TEMPERATE FORAGE MIXTURE: II. RAINFALL RUNOFF AND SOIL CHEMICAL PROPERTIES,
Agricultural Research Service, Raleigh, NC. Dept. of Agricultural and Biological Engineering.
P. W. Westerman, L. D. King, J. C. Burns, G. A. Cummings, and M. R. Overcash.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 2, p 106-112, April-June 1987. 4 fig, 5 tab, 37 ref.

Descriptors: *Animal wastes, *Lagoon effluents, *Forages, *Waste disposal, *Land disposal, *Nutrients, *Water pollution effects, Groundwater, Grasses, Rainfall, Runoff, Soil chemistry, Manure.

Rates of swine (Sus scrofa domesticus) waste used for crop production must be sufficient to supply adequate nutrients but must not pose a surface or groundwater pollution hazard. To determine acceptable rates, plots of predominantly tall fescue (Festuca arundinacea L. Schreb) on a Cecil soil (Typic Hapludults) received no treatment (C); commercial fertilizer (F) at 201-34-65 kg N-P-K/ha/yr, swine manure slurry (M) supplying 670 kg N/ha/yr, or swine lagoon effluent (E) applied by sprinkler irrigation to supply 600 (E1) or 1200 (E2) kg/N/ha/yr for 4 yr. The waste treatments, chosen to evaluate acceptable maximum application rates when land is limited, resulted in much higher applications of N, P, K, and other nutrients than are normally used for temperate species. Runoff from E2 had an annual mean concentration of 13 mg/L/NO3-N but the low runoff volume resulted in mass transport of only about 10 kg/NO3-N/ha/yr. Concentration of P was significantly higher with E2 (9 mg/L) and M (6 mg/L) than with the other treatments. The runoff quality from E1 was not significantly different than that from F. Soil NO3-N concentrations to a depth of 200 cm showing significant differences in the order E2 = M > E1 > F = C. For E2, 49% of the applied N could not be accounted for by crop removal, increased soil NO3-N, or runoff. Mehlich 1 extractable P was greater with E2 than with the other treatments. Extractable soil K and Na were increased by E1 and E2 but treatments had little or no effect on extractable Ca, Mg, Cu, Zn, Mn, or on total N, organic matter, or pH. Analysis of runoff and soil NO3-N data indicate that M, E2, and perhaps E1 supplied excess N. Consequently, surface and groundwater pollution hazards may be created by applying manure and effluent at the rates studied. Pollution by runoff was more likely when rainfall occurred soon after manure or fertilizer application. (See also W87-08919) (Author's abstract)
W87-08920

RESIDUAL EFFECTS OF SEWAGE SLUDGE ON SOYBEAN: I. ACCUMULATION OF HEAVY METALS,
Maryland Univ., College Park. Dept. of Agronomy.
J. R. Heckman, J. S. Angle, and R. L. Chaney.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 2, p 113-117, April-June 1987. 9 tab, 20 ref.

Descriptors: *Bioaccumulation, *Path of pollutants, *Water pollution effects, *Sludge disposal, *Land disposal, *Soybeans, *Heavy metals, Field tests, Food crops, Growth.

The potential for excessive crop uptake of heavy metals from land previously amended with sludge is of concern because of the persistence of heavy metals. Field studies were therefore conducted at two locations in 1983 and 1984 to examine the residual effects of sewage sludge on heavy metal uptake by soybean (Glycine max (L.) Merr.). The Fairland plots (Typic Hapludults) had been amended with two rates of anaerobically digested sludge in 1975. The Beltsville plots (Typic Paleudults) had been established in 1976 with limed-anaerobically digested, limed-raw, limed-compost, or heat-treated sludge and in 1978 with Nu-Earth (Chicago, IL) anaerobically digested sludge. Treatments consisted of various sludge rates and pH regimes. The concentrations of metals in soybean shoots at the R4 growth stage varied according to sludge type, application rate, and soil pH. Metal uptake from low metal, limed sludges was similar to that of controls. Metal uptake was, however, increased by unlimed sludges that were high in metal content. Digested sludge linearly increased shoot metal concentrations of Zn, Cd, Cu, and Ni. Compared to the unamended control, soybean Zn increased from 24 to 165 mg/kg and Cd increased from0.06 to 0.25 mg/kg at the 112 Mg/ha rate. The shoot Cd concentration was over seven times higher from Cd rich Nu-Earth sludge as compared to the other sludges. Shoot Zn and Cd concentrations exhibited significant linear and quadratic relationships with rates of heat-treated and Nu-Earth sludge. There was a greater response of shoot Zn and Cd accumulation to sludge rate at low soil pH. At the 100 Mg/ha rate of Nu-Earth sludge, soybean Zn and Cd concentrations, respectively, were 59 and 1.75 mg/kg at soil pH 6.4 and 84 and 2.54 mg/kg at soil pH 5.8. These results indicate that sludge composition and soil pH can have a substantial influence on soybean metal uptake for at least 9 yr after the initial sludge application. (See also W87-08922) (Author's abstract)
W87-08921

RESIDUAL EFFECTS OF SEWAGE SLUDGE ON SOYBEAN: II. ACCUMULATION OF SOIL AND SYMBIOTICALLY FIXED NITROGEN,
Maryland Univ., College Park. Dept. of Agronomy.
J. R. Heckman, J. S. Angle, and R. L. Chaney.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 2, p 118-124, April-June 1987. 3 tab, 25 ref.

Descriptors: *Bioaccumulation, *Path of pollutants, *Water pollution effects, *Sludge disposal, *Land disposal, *Soybeans, *Heavy metals, *Nitrogen fixation, Field tests, Food crops, Growth, Moisture stress.

Nitrogen and heavy metals derived from sewage sludge may potentially affect N2 fixation and soybean (Glycine max (L.) Merr.) growth. Field studies were conducted at two locations in 1983 and 1984 to examine the residual effects of sewage sludge on N2 fixation in soybean. The Fairland plots (Typic Hapludults) were amended with two rates of anaerobically digested sludge in 1975. The Beltsville plots (Typic Paleudults) were established in 1976 with limed-anaerobically digested, limed-raw, limed-compost, or heat-treated sludge, and in 1978 with Nu-Earth (Chicago, IL) anaerobically digested sludge. Nonnodulating and nodulating isolines of 'Clark' soybean were grown on the sludge-treated plots, which consisted of various sludge rates and pH regimes. Dry matter and total N accumulation were determined in the shoots at the R4 stage of maturity. Dry matter and N accumulation by nonnodulating soybean generally increased due to greater availability of soil N on the sludge plots. In nodulating soybean, dry matter production and N2 fixation were enhanced by most sludges with the greatest increase occurring under moisture stress. In 1983, a dry year, dry matter of nodulating soybean and N2 fixation (estimated by the difference method) were increased by all sludges at Beltsville. During this year, dry matter and amount of N fixed increased from 16.5 g/plant and 285 mg/N plant (control) to 31.1 g/plant and 706 mg/N/plant at the 672 Mg/ha limed-compost sludge rate, respectively. In 1984, a normal rainfall year, dry matter and N2 fixation was moderately higher on sludge plots compared to control levels. Dry matter and N2 fixation showed a quadratic response due to overliming by high applications of limed-digested and limed-raw sludges. Evidence for toxicity of sludge metals on N2 fixation was not found at Beltsville sludge plots. However, a toxic effect may be suggested by high metal sludge at Fairland sludge plots. In addition to a decrease in the amount of N2 fixed, nonnodulating plant dry matter increased with sludge, whereas nodulating plant dry matter decreased. Results suggest that while sludge amended soil may enhance soybean growth, such beneficial results may be limited to sludges low in heavy metals. (See also W87-08921) (Author's abstract)
W87-08922

SOYBEAN GROWTH AND BORON DISTRIBUTION IN A SANDY SOIL AMENDED WITH SCRUBBER SLUDGE,
Minnesota Agricultural Experiment Station, St. Paul.
L. S. Ransome, and R. H. Dowdy.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 2, p 171-175, April-June 1987. 1 fig, 3 tab, 24 ref.

Descriptors: *Water pollution effects, *Sludge disposal, *Land disposal, *Path of pollutants, *Soybeans, *Boron, Agriculture, Field tests, Food crops, Growth, Nutrients, Leaching, Toxicity.

A field study was conducted to determine the feasibility of using scrubber sludge residues from coal-fired generation of electricity as an agricultural soil amendment. Boron distribution between plant, soil, and soil water was monitored to determine whether scrubber sludge application would

enhance crop growth by alleviation of the B-deficient status of an irrigated Hubbard loamy sand (Udorthentic Haploborolls) without elevation of soil or soil-water B to phytotoxic levels. Soybean (Glycine max L.) plants were grown on plots amended with 0, 10, 20, and 40 Mg scrubber sludge/ha. Effects on plant populations, bean yield and nutrient content, B availability, soil-water B concentration, and electrical conductivity (EC) were measured for three growing seasons. Hot-water extractable soil B was elevated from low (0.40 mg/kg) to sufficiency levels (> 1.0 mg/kg) by application of at least 20 Mg scrubber sludge/ha; such levels were maintained for two to three growing seasons. Soil-water EC and B concentrations reached levels potentially detrimental to soybean production during the application year at the 40 Mg/ha rate. Elevated soil-water EC and B levels were mediated after the first growing season as leaching removed excess soluble components from the root zone. Soybean populations decreased linearly with increasing rates of application the first two growing seasons following application. Yield was significantly reduced the first year but was enhanced in response to scrubber sludge application the third growing season. Leaf B content was significantly increased all 3 yr; symptoms of B toxicity were visible only during the year of application. Seed B, although significantly affected by treatment, did not parallel leaf B or yield. (Author's abstract)
W87-08927

SOIL CLOGGING DURING SUBSURFACE WASTEWATER INFILTRATION AS AFFECTED BY EFFLUENT COMPOSITION AND LOADING RATE,
Wisconsin Univ.-Madison. Coll. of Agricultural and Life Sciences.
R. L. Siegrist.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 2, p 181-187, April-June 1987. 4 fig, 4 tab, 27 ref.

Descriptors: *Water pollution effects, *Soil clogging, *Infiltration, *Effluents, *Impaired water use, *Model studies, Soil properties, Suspended solids, Field tests.

The soil clogging effects of wastewater effluent composition and loading rate were investigated in pilot-scale infiltration cells installed in situ in the structured silty clay loam subsoil of a Typic Argiudoll (fine-silty, mixed, mesic). Over a 70-month period domestic septic tank effluent (DSTE), graywater septic tank effluent (GSTE and tapwater (TW) were intermittently applied in an average of 5.2 cm/d and in all DSTE treatments, severe soil clogging led to continuous ponding of the soil infiltrative surfaces. A logistic model fit to the experimental data confirmed that soil clogging development was highly correlated with the cumulative mass density loadings of total biochemical oxygen demand and suspended solids. After 62 and 70 months of loading, soil properties were determined with depth. Clogged infiltrative surface zones exhibited significant accumulations of organic materials at the infiltrative surface and within the first few millimeters of the soil matrix. This field study demonstrated that higher quality wastewater effluents can be discharged to subsurface infiltration systems at hydraulic loading rates in excess of those utilized for DSTE without stimulating soil clogging development. (Author's abstract)
W87-08928

COMPARATIVE EFFECTS OF MINE WASTES ON THE BENTHOS OF AN ACID AND AN ALKALINE POND,
Quebec Univ., Montreal. Dept. des Sciences Biologiques.
P. Wickham, E. van de Walle, and D. Planas.
Environmental Pollution, Vol. 44, No. 2, p 83-99, 1987. 2 fig, 3 tab, 51 ref.

Descriptors: *Tailings ponds, *Benthos, *Water pollution effects, *Limnology, *Acid ponds, *Alkaline ponds, *Mine wastes, Bioaccumulation, Heavy metals, Sediments, Aquatic insects.

Benthic invertebrates collected from an acid (pH 3.2) and an alkaline (pH 7.9) tailing pond in the Rouyn-Noranda mining region were compared with those of a control pond in order to assess the effects of the pH on the benthic community structure and on metal accumulation by invertebrates. The acid pond showed high mean soluble concentrations of aluminum (2600 ppb), copper (230 ppb), iron (6500 ppb) and zinc (4900 ppb) in the water and high mean concentrations of copper (340 ppm), iron (15,238 ppm) and zinc (445 ppm) in the sediments. The benthic fauna was dominated by Chironomus spp and the water beetle Ilybius sp. The Shannon-Weaver diversity index was 0.04. The alkaline pond had high mean sediment concentrations of cadmium (21 ppm), iron (15,823 ppm), manganese (658 ppm) and nickel (146 ppm). A total of 37 insect genera and a diversity index of 3.4 were recorded for this pond. Of the seven metals studied only copper and aluminum showed greater accumulations in the biota of the contaminated ponds than in that of the control. Insects dominated the benthic fauna in both contaminated ponds and crustacea in the control. (Author's abstract)
W87-08962

EFFECTS OF LOW AMBIENT PH ON PERIVITELLINE FLUID OF AMBYSTOMA MACULATUM (SHAW) EGGS,
Acadia Univ., Wolfville, (Nova Scotia). Dept. of Biology.
L. Robb, and D. Toews.
Environmental Pollution, Vol. 44, No. 2, p 101-107, 1987. 1 fig, 1 tab, 9 ref.

Descriptors: *Ambystoma, *Water pollution effects, *Fish eggs, *Ponds, *Acid rain, *Nova Scotia, *Perivitelline fluid, *Acidity, Larvae, Hatching, Reproduction.

Egg clumps of Ambystoma maculatum were collected from a pond on the south side of the Gaspereau Valley, Kings County, Nova Scotia, to determine the effects of low ambient pH levels on the perivitelline fluid pH. Egg masses were placed in aquaria filled with pond water adjusted to pH 4.0, 5.0, 6.0 and 7.0. Perivitelline fluid was withdrawn from the eggs at 1, 3, 5, 7, 24, 48, 96 and 120 h after initial immersion, and its pH measured. Initial perivitelline fluid values decreased significantly 7 to 96 h after initial immersion in treatments altered to pH 4.0 and 5.0. Rate of H(+) influx into the perivitelline fluid is much greater in eggs immersed in water at pH 4 than in water at pH 5 or 6. Medium Tolerance Limit tests indicated a critical pH value between 3.5 and 4.0 for newly hatched larvae. (Author's abstract)
W87-08963

FACTORS INFLUENCING ACUTE TOXICITY OF COAL ASH TO RAINBOW TROUT (SALMO GAIRDNERI) AND BLUEGILL SUNFISH (LEPOMIS MACROCHIRUS),
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
D. S. Cherry, J. H. Van Hassel, P. H. Ribbe, and J. Cairns.
Water Resources Bulletin WARBAQ, Vol. 23, No. 2, p 293-306, April 1987. 3 fig, 6 tab, 50 ref.

Descriptors: *Bioassay, *Water pollution effects, *Coal ash, *Trout, *Bluegills, *Toxicity, Heavy metals, Fly ash, Mortality, Acidity, Effluents, Fish.

The potentially toxic components in coal ash (ash particles, heavy metals) were evaluated in laboratory static, acute (96 hr) bioassays, both separately and in various combinations with extreme pH (5.0 and 8.5), using rainbow trout (Salmo gairdneri) and bluegill sunfish (Lepomis macrochirus). Ash particle morphology and metal distribution analysis, using electron microscopy and surface-subsurface analysis by ion microscopy, showed that metals could be either clumped or evenly distributed on the surface of fly ash. Surface enrichment on fly ash particles from electrostatic precipitators, as measured by ion microscopy, was found for cadmium, copper, chromium, nickel, lead, mercury, titanium, arsenic, and selenium. Bottom (heavy) ash was not acutely toxic to either fish species at concentrations of up to 1500 mg/l total suspended solids (TSS) at pH 5.0, 7.5, or 8.5. Fly ash particles were not acutely toxic to bluegill at levels up to 1360 mg/l TSS. Rainbow trout were highly sensitive to fly ash (25 to 60 percent mortality) at concentrations of 4.3 to 20.5 mg/l TSS when dissolved metal availability was high but were not sensitive at higher particulate concentrations (58 to 638 mg/l TSS) when dissolved metals were low. When metals were acid-leached from fly ash prior to testing, no rainbow trout mortality occurred at TSS concentrations of up to 2,350 mg/l TSS. When the percent of dissolved metal was high (e.g., 50-90 percent of the total), fish mortality was increased. Rainbow trout were nearly two orders of magnitude more sensitive than bluegill when subjected to a blend of cadmium, chromium, copper, nickel, lead, and zinc. The two species were similar in their acute sensitivity to acidic pH at levels at or below 4.0 and alkaline pH of 9.1. If the pH of coal ash effluent is contained within the range 6.0 to 9.0, acute toxicity to fish can be attributed to trace element availability from fly ash but not heavy ash. Control of holding pond and effluent pH and maximizing pond residence time are important strategies for minimizing effects of ash pond discharges on fish. (Author's abstract)
W87-08978

EFFECT OF SEWAGE SLUDGE ON SOIL STRUCTURAL STABILITY: MICROBIOLOGICAL ASPECTS,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
L. Metzger, D. Levanon, and U. Mingelgrin.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 346-351, March-April 1987. 5 fig, 3 tab, 28 ref. Israel National Council for Research Grant WT 222.

Descriptors: *Microbiological studies, *Water pollution effects, *Waste disposal, *Sludge disposal, *Land disposal, *Soil water, Loess, Soil properties, Aggregates, Bacteria, Fungi, Incubation, Carbohydrates.

The effect of the addition of sewage sludge on the content of water-stable aggregates (WSA) in a structureless loessial soil was studied in a 54-d incubation experiment. The changes in the WSA content after addition of 5% sludge were characterized by a phase of WSA formation (lasting about 10 d at 25 C) and a phase of decreasing WSA content leading to a constant WSA level. The first phase was associated with a sharp increase in bacterial and fungal populations, a high rate of CO2 evolution and an increase in the water-soluble carbohydrate (WSC) content. At 25 C, the WSA content in the sludge-amended soil remained higher than in the unamended soil until the end of incubation. Selective inhibition treatments enabled the assessment of the relative importance of the main microbial groups in the formation of WSA. Fungal activity was best correlated with structural stability in the soil-sludge mixtures. Relatively high correlations were found between the WSA level and between both the fungal counts and the water-soluble anthrone-reactive carbohydrate content. This suggests that cementing by fungal carbohydrates and physical entanglement by mycelium may act as binding mechanisms involved in the formation of WSA when sludge is applied to soil. (Author's abstract)
W87-08997

CHEMICAL CONTAMINANTS IN BOTTOM-FISH,
Seattle-King County Dept. of Public Health, WA.
For primary bibliographic entry see Field 5B.
W87-09035

HANDBOOK OF CHLORINATION,
For primary bibliographic entry see Field 5D.
W87-09064

MATHEMATICAL STUDY OF THE IMPACT ON SALINITY INTRUSION OF DEEPENING THE LOWER MISSISSIPPI RIVER NAVIGATION CHANNEL,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 5B.
W87-09095

COMPARATIVE TOXICITY OF SRC-I WASTEWATER TO AQUATIC ORGANISMS,
International Coal Refining Co., Allentown, PA.
H. C. Bailey.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as DE84-013977. Price codes: A04 in paper copy, A01 in microfiche. DOE Report No. DOE/OR/03054-91. January 1984. 52 p, 10 fig, 22 tab, 7 ref.

Descriptors: *Water pollution effects, *Toxicity, *Daphnia, *Activated carbon, Wastewater treatment, Ecological effects, Phenols, Industrial wastes, Algal growth, Environmental effects, Comparison studies, Water quality, Minnows, Bioassay.

SRI International performed a series of acute and chronic toxicity studies on SRC-I wastewaters using fish, zooplankton, and algae as test organisms. The tests were designed to determine the toxicity of SRC-I wastewaters to aquatic organisms and, based on differences in toxicity of the various water samples, to evaluate the efficacy of various wastewater treatment methods. Survival data from acute and chronic daphnid studies indicate that phenol recovery markedly reduced wastewater toxicity. In treatment processes that did not include phenol recovery, powdered activated carbon reduced toxicity more effectively than granulated activated carbon. All treated water supported algal growth in excess of that in controls, particularly those waters subjected to phenol recovery. The toxicity of each SRC-I wastewater sample was compared with that of a corresponding synthetic salt solution to determine whether the salt load was the toxic element. The wastewaters typically exhibited higher toxicity than their associated salt solutions. The effect was greatest in the daphnid chronic studies. (Author's abstract)
W87-09106

REPORT OF THE ACID RAIN PEER REVIEW PANEL.
For primary bibliographic entry see Field 5B.
W87-09107

SAFE DRINKING WATER: THE IMPACT OF CHEMICALS ON A LIMITED RESOURCE.
Drinking Water Research Foundation, Alexandria, VA.
Lewis Publishers, Inc. Chelsea, Michigan. 1985. 275 p. Edited by Rip G. Rice.

Descriptors: *Drinking water, *Water pollution effects, *Water treatment, *Disinfection, *Water pollution sources, Water quality control, Monitoring, Chlorination, Ozonation, Groundwater pollution, Groundwater management, Water analysis, Public health, Symposium, Chemical treatment.

A symposium was sponsored by the Drinking Water Research Foundation and the American Chemical Society to address one of the major issues confronting the future of the nation's drinking water supplies, chemical contamination. The 18 papers presented during this symposium, along with two additional papers, cover the following topics: national and international perspectives, sources and distribution of safe drinking water, public drinking water, bottled water, point-of-use water treatment, regulation of indirect additives to drinking water, water treatment chemicals codex, impacts of chemical disinfectants on water quality, chlorination by-products, ozonation, sources of groundwater contamination, groundwater quality monitoring, NBS environmental standard reference materials for use in water analysis, and various regulatory aspects to assure drinking water quality. While all the situations, problems and alternatives are not discussed in these proceedings, it is hoped that some attention will be brought to the public, government, and private sectors so that future work will be done to assure the nation of safe drinking water resources. (See W87-09115 thru W87-09133) (Geiger-PTT)
W87-09114

CHEMICALS AND SAFE DRINKING WATER: NATIONAL AND INTERNATIONAL PERSPECTIVE,
Chemical Industry Inst. of Toxicology, Research Triangle Park, NC.
R. A. Neal.
IN: Safe Drinking Water: The Impact of Chemicals on a Limited Resource. Lewis Publishers, Chelsea, Michigan. 1985. p 1-8, 4 ref.

Descriptors: *Drinking water, *Water pollution effects, *Public health, *Epidemiology, *Organic compounds, Water quality control, Toxicity, Chlorinated hydrocarbons, Disinfection, Heavy metals, Pesticides, Phenols, Radioisotopes, Chemical treatment, Benzenes, Bioassay, Inorganic compounds.

The assessment and control of the potential health effects attendant with chemical contamination of water are much more difficult than those associated with microbial contamination of water. Epidemiological surveys of populations consuming chemically contaminated water show a consistent relationship between the chemical contamination and incidence of cancer, heart disease and hypertension. A few compounds which produce cancer in humans and a large number which produce cancer in experimental animals have been detected in finished drinking water. However, there is no information on the potential human toxicity of the majority of the organic compounds present in drinking water. Consideration is being given to carrying out animal tests with representative mixtures of the chemicals present in drinking water supplies. This will automatically take into account the possible antagonistic, additive, or synergistic effects which may occur between toxic compounds present in drinking water. (See also W87-09114) (Geiger-PTT)
W87-09115

DRINKING WATER: A GLOBAL VICTUAL,
Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
J. R. Hickman, and B. Pharm.
IN: Safe Drinking Water: The Impact of Chemicals on a Limited Resource. Lewis Publishers, Chelsea, Michigan. 1985. p 9-20. 1 tab, 37 ref.

Descriptors: *Drinking water, *Public health, *Toxicity, *Disinfection, *Epidemiology, *Water pollution effects, Water quality, Organic compounds, Water pollution sources, Water distribution, Chlorination, Ozonation, Water treatment, Chemical treatment, Nonpoint pollution sources.

All societies depend on water. Pure water is rare in nature; water carries and dissolves many other substances. Some of these substances are beneficial to human health while others have adverse effects. Unlike other natural resources, water has been regarded traditionally as a free good. It has been overused and wasted to the point of becoming scarce in many parts of the world. Three broad categories of substances affecting the quality of raw water sources are discussed: naturally-occurring substances, point sources of pollution, and diffuse (non-point) sources which contribute significantly to the background composition of drinking water supplies. The benefits and disadvantages of various methods of water treatment such as chlorination, and use of chlorine dioxide, ozone, iron and aluminum salts and flocculation adjuncts are considered. Contamination in the distribution system occurs from asbestos in cement piping, metals from pipes and storage tanks, and organics from plastic structures. The significance of some organic and inorganic chemicals in relation to human health are discussed in terms of toxicity, mutagenicity and carcinogenicity tests and epidemiological studies. (See also W87-09114) (Geiger-PTT)
W87-09116

PUBLIC DRINKING WATER AND CHEMICALS,
American Water Works Association Research Foundation, Denver, CO.
J. F. Manwaring.
IN: Safe Drinking Water: The Impact of Chemicals on a Limited Resource. Lewis Publishers, Chelsea, Michigan. 1985. p 21-31, 1 tab, 12 ref.

Descriptors: *Drinking water, *Public health, *Water pollution effects, *Water treatment, *Water pollution sources, Economic aspects, Disinfection, Chlorination, Chlorine, Groundwater pollution, Water quality, Water quality control, Chemical treatment, Organic compounds.

The impacts of chemicals on drinking water are summarized from the water utility point of view. Chemical contamination of drinking water sources has reduced the usability of some water resources for potable purposes, especially for small water supply systems that do not have the financial nor the technological basis to solve the problems. The water utility manager must evaluate the question of responsibility with respect to man-made chemical contamination of a drinking water source. Water suppliers need more and better research on the health effects of contaminants to provide a more reliable basis for evaluating any additional water quality standards. Water suppliers also require cooperation and action from government, industry, agriculture and the public in protecting drinking water sources from pollution. (See also W87-09114) (Geiger-PTT)
W87-09117

WORLD HEALTH ORGANIZATION AND GUIDELINES AND EUROPEAN ECONOMIC COMMUNITY DIRECTIVES,
Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
For primary bibliographic entry see Field 6E.
W87-09130

AMERICAN WEST'S ACID RAIN TEST,
California Univ., Berkeley. Energy and Resources Group.
For primary bibliographic entry see Field 5B.
W87-09160

IMPORTANCE OF ATMOSPHERIC FLUXES TO THE NITROGEN BALANCE OF LAKES IN THE FLORIDA PENINSULA,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 2H.
W87-09176

ATMOSPHERIC DEPOSITION OF ACIDITY AND SULFUR IN FLORIDA,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5B.
W87-09177

LICHENS AS MONITORS OF ATMOSPHERIC DEPOSITION,
Laurentian Univ., Sudbury (Ontario). Dept. of Biology.
E. Nieboer, and D. H. S. Richardson.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 339-388, 11 fig, 9 tab, 125 ref.

Descriptors: *Bioindicators, *Fate of pollutants, *Air pollution, *Lichens, *Water pollution effects, *Acid rain, Algae, Fungi, Monitoring, Environmental effects, Industrial emissions, Sulfur dioxide.

Lichens are a group of plants in which the plant body or thallus consists of fungal tissue. Microscopic photosynthetic algae are embedded in the fungal tissue, usually forming a distinct layer. The two organisms comprise an intimate symbiotic association. There are approximately 20,000 lichen species but the majority (the crustose lichens) form crusts on rock or trees and are of little value in monitoring atmospheric deposition as they are somewhat difficult to identify and separate from their substrates. The deposition of material from

the atmosphere onto lichens results in elevated levels of specific elements being observed in these plants. Such levels may induce changes in the appearance or growth habit of the lichen or indeed cause its death. Lichens do not possess a protective cuticle or roots. Presumably because of these characteristics, they have evolved efficient uptake mechanisms to enable them to accumulate substances and particulates from air or rain water. The uptake of toxic substances, especially sulfur dioxide, may kill the lichen, and with time the consequence may be a change in the lichen species composition of an area. A reduction in diversity and abundance of lichens may be observed or ultimately there may be a 'lichen desert' typical of the central areas of many urban and industrial centers. Analysis of the lichen flora in terms of diversity and abundance around factories or towns can enable the calculation of an index of atmospheric purity (IAP). This paper is concerned with the value of lichens in defining the zone of influence around industrial emission sources. A compilation is provided of the type and concentration of elements found in lichens collected around such sources of pollution. A discussion also follows of the various mechanisms by which elements are accumulated by lichens, and models are examined which help to account for the observed deposition of elements in relation to distance of collection from the emission source. Considerations of the toxicity of sulfur dioxide and metals to lichens are given. And, finally, a technique by which laboratory studies may be employed to aid the prediction of permissible atmospheric concentrations of sulfur dioxide not detrimental to lichens is examined in some detail. (Lantz-PTT)
W87-09181

USE OF BOG VEGETATION AS A MONITOR OF ATMOSPHERIC INPUT OF METALS,
National Water Research Inst., Burlington (Ontario).
W. A. Glooschenko, R. Sims, M. Gregory, and T. Mayer.
IN: Atmospheric Pollutants in Natural Waters, Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. p 389-399, 5 fig, 2 tab, 15 ref.

Descriptors: *Water pollution effects, *Bioindicators, *Bogs, *Aquatic plants, *Metals, *Path of pollutants, *Sudbury, *Ontario, Environmental effects, Sampling, Monitoring, Mosses, Lichens, Fate of pollutants, Wetlands.

Recent interest in the deposition of heavy metals by atmospheric processes has led to various means of monitoring such a process. Direct methods of precipitation and/or atmospheric particle sampling require installation of various devices and subsequent maintenance. This can be fairly expensive in remote northern areas. Sampling of lake sediments or soils can lead to problems of interpretation due to changes in watershed chemistry and erosion processes plus migration of chemical species in the sediment column. To alleviate some of these concerns, sampling of plants for elemental analysis has been done. Emphasis has been placed on lower plants such as mosses and lichens. Mosses and lichens have been sampled from various sources including those growing on trees (epiphytic species), or those growing on rocks (epilithic species) or on the forest floor. Problems can exist using these species such as contamination by dust or mineral soils, or interception losses from tree canopies. In order to alleviate these problems, investigators have resorted to sampling mosses and lichens growing in bog ecosystems which are ombrotrophic, i.e., receiving all nutrient and metal inputs solely from atmospheric sources. Previous studies of bog vegetation have emphasized mosses of the species Sphagnum. The present study had two purposes: (1) to determine the relationship between metal levels in bog mosses and higher vegetation such as shrubs and trees in such ecosystems, and (2) to determine the influence of the smelter complex at Sudbury, Ontario, on metal content of bog vegetation. (See also W87-09164) (Lantz-PTT)
W87-09182

IMPACT OF AGRICULTURE ON SURFACE WATER IN IRELAND: PART I. GENERAL,
Foras Forbartha, Teoranta, Dublin (Ireland). Water Resources Div.
For primary bibliographic entry see Field 5B.
W87-09199

IMPACT OF AGRICULTURE ON SURFACE WATER IN IRELAND: PART II. PROSPECTS FOR THE FUTURE,
Foras Taluntais, Ballinrobe (Ireland). Johnstown Castle Research Centre.
For primary bibliographic entry see Field 4C.
W87-09200

PERENNIAL PASTURE PRODUCTION AFTER IRRIGATION WITH SALINE GROUNDWATER IN THE GOULBURN VALLEY, VICTORIA,
Department of Agriculture and Rural Affairs, Victoria (Australia). Inst. for Irrigation and Salinity Research.
For primary bibliographic entry see Field 3C.
W87-09208

PUBLIC HEALTH SIGNIFICANCE OF INDUSTRIAL POLLUTION IN ZARIA, NIGERIA,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Veterinary Public Health and Preventive Medicine.
For primary bibliographic entry see Field 5B.
W87-09226

FRESHLY PREPARED RAT HEPATOCYTES USED IN SCREENING THE TOXICITY OF BLUE-GREEN ALGAL BLOOMS,
Norwegian College of Veterinary Medicine, Oslo. Dept. of Food Hygiene.
For primary bibliographic entry see Field 5A.
W87-09230

INFLUENCE OF SIMULATED ACIDIC RAIN ON VEGETATIVE AND REPRODUCTIVE TISSUES OF CUCUMBER (CUCUMIS SATIVUS L.),
Boyce Thompson Inst. for Plant Research, Ithaca, NY.
J. S. Jacobson, J. Osmeloski, K. Yamada, and L. Heller.
New Phytologist NEPHAV, Vol. 105, No. 1, p 139-147, January 1987. 6 tab, 23 ref.

Descriptors: *Acid rain, *Plant growth, *Plant tissues, *Water pollution effects, *Cucumbers, *Simulated rainfall, Environmental effects, Vegetation effects.

Cucumber plants were grown in a greenhouse and exposed 21 times to simulated acidic rain over a period of 6 weeks to compare the responses of vegetative and reproductive tissues. Chemical composition and temporal characteristics of rain were patterned according to rainfall in the growing season in the eastern U.S. Flowers were hand-pollinated to promote fruitset. Foliar symptoms were the most sensitive response of all the variables measured. Necrosis was visible after exposures to simulated acidic rain at pH 2.6, 3.0, and 3.4 but not at 3.8, 4.2, 4.6, 5.0, or 5.4. Despite these injury symptoms, there were no significant reductions in most measures of vegetative or reproductive tissues, even at pH 2.6. When durations of exposure were increased from 80 to 160 min, there was an increase in the severity of foliar injury, a significant reduction in dry mass of stems, numbers of female flowers produced and dry mass of flowers and immature fruit. However, there still were no significant reductions in numbers or weight of fruit, even though the plants were exposed to as much as a 20-fold greater deposition of acidity than ambient rainfall (average pH 4.0 to 4.3) in the northeeastern U.S. Evidently, cucumber plants have the capacity to recover and compensate for initial decreases in foliage and flower production, and the reproductive stage is not particularly susceptible to simulated acidic rain. These findings support previous results indicating that considerable increases in acidity of ambient rain would have to occur before the yield of crops would be measurably reduced. (Author's abstract)
W87-09232

LETHAL EFFECTS OF DIQUAT AND PARAQUAT ON DEVELOPING FROG EMBRYOS AND 15-DAY-OLD TADPOLES, RANA PIPIENS,
Department of Life Sciences, Indiana State Univ., Terre Haute, IN.
N. A. Dial, and C. A. B. Dial.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 6, p 1006-1011, June 1987. 1 tab, 15 ref.

Descriptors: *Water pollution effects, *Diquat, *Paraquat, *Frogs, *Embryos, *Tadpoles, *Rana, Herbicides, Toxicity, Hatching, Population exposure, Survival, Mortality.

Diquat (6,7-dihydrodipyrido (1,2-a:2',1'-c) pyrazinedium) and paraquat (1,1'-dimethyl-4,4'-bipyridinium dichloride) are widely used in agriculture and in the control of aquatic weeds. The rate of application for aquatic weed control is similar for both herbicides and usually ranges from about 0.1 to 2.0 parts per million (ppm), by weight in water. Survivability data are presented, and discussed. Eggs of Rana pipiens were found to be resistant to diquat and paraquat as development proceeded normally to hatch (day 4) in all groups. No significant differences in survivability were detected. Because plants can concentrate astonishing levels of diquat and paraquat it would be important to learn whether consumption of diquat or paraquat contaminated plants or plant detritus by tadpoles is lethal. After hatch, aquatic application levels of paraquat produced significant mortality for both treatment regimes, i.e., exposure beginning at the early gastrula stage of development and at 15 days of age. Common aquatic application levels of diquat did not produce significant mortality for either treatment regime. (Alexander-PTT)
W87-09235

TOXIC EFFECTS OF ORGANIC SOLVENTS ON THE GROWTH OF BLUE-GREEN ALGAE,
Dept. of Biology, Environmental Microbiology Lab., Nova Scotia Agricultural Coll., Truro, Nova Scotia, Canada B2N 5E3.
G. W. Stratton.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 6, p 1012-1019, June 1987. 2 tab, 20 ref.

Descriptors: *Water pollution effects, *Organic solvents, *Algal growth, *Cyanophyta, *Toxicity, *Bioassay, Acetone, Dimethyl sulfoxide.

Bioassays are an important means of gathering data on the potential environmental impact of various pollutants. An increased awareness of the ecological ramifications of pollution and its possible legal implications has highlighted the importance of standardizing and improving bioassay methodology to ensure the acquisition of accurate, reproducible toxicity data with which to make in situ environmental predictions. One area of concern with laboratory bioassays is the stress imposed on test organisms by organic solvents. Organic solvents can make their way into the environment as industrial wastes and components of pesticide formulations. In laboratory bioassays, the use of organic solvents is often unavoidable, since many pesticides and organic pollutants have low water solubility and must be dissolved in organic solvents prior to addition into experimental systems. In order to ensure that a given solvent does not interfere with a test toxicant's effects in bioassays, a procedure similar to that published by Stratton et al. must be followed. However, it is first necessary to choose a solvent which has low toxicity to the test organism used. Unfortunately, information on the comparative effects of solvents towards microbial test systems is limited and more research is required to provide these data. Based upon the results presented here, acetone or DMSO would be suitable solvents to use in bioassays with blue-green algae, provided that they did not interact with the particular toxicant being tested. (Alexander-PTT)
W87-09236

SHORT-TERM EFFECTS OF POLYNUCLEAR AROMATIC HYDROCARBONS ON SEA-SURFACE MICROLAYER PHYTONEUSTON,

Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.
R. Z. Riznyk, J. T. Hardy, W. Pearson, and L. Jabs.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 6, p 1037-1043, June 1987. 2 fig, 14 ref. Northwest College and University Association for Science Contract DE-AM06-76-RL02225; NOAA Contract DE-AC06-76-RL01830;.

Descriptors: *Polynuclear aromatic hydrocarbons, *Carcinogens, *Priority pollutants, *Fluoranthene, *Phytoneuston, Growth, Microalgae.

Polynuclear aromatic hydrocarbons (PAHs) are of ecological concern because they are the most widespread class of chemical environmental contaminant, having an estimated annual discharge into aquatic ecosystems of 230,000 metric tons. These pollutants are of special interest to biologists because of their localization in rivers, estuaries, and coastal waters where they quickly become adsorbed by organic and inorganic particulate matter and are readily accumulated by aquatic biota. Since these chemical compounds are lipophilic, they are incorporated into both plant and animal tissue, purportedly by passive diffusion and/or active metabolism. The toxic nature of PAHs is of current concern. The Environmental Protection Agency has identified 16 different PAHs as priority pollutants because of their potentially harmful effects to the environment and their known carcinogenic and mutagenic capabilities. Concentrations of 1 mg/L of the PAH fluoranthene in mineral oil had a definite impact on the growth rate of phytoneuston during the initial 48-h exposure period. It appears that fluoranthene either retarded reproduction and/or contributed to the mortality of established microalgae communities during short-term exposure. A relatively low growth rate of phytoneuston that occurred in the unaugmented mineral oil can perhaps be attributed to PAH impurities present in the liquid paraffin. A more plausible explanation, however, is that the viscous mineral oil acted as a physical barrier that delayed the dispersion of newly formed daughter cells. Even though the surfactant Tween 80 reduced the surface tension to allow the oil to spread, the viscosity may have been high enough to hamper dispersion. After four days the untreated control and 1 mg/L fluoranthene-treated phytoneuston communities showed nearly identical growth rates. Apparently the microflora was able to adapt to the PAH concentration and grow unimpeded to equal the rate of growth of the control community, which slowed after a very rapid initial increase. (Alexander-PTT)
W87-09238

FEEDING REDUCTION AND RECOVERY IN CUNNER TAUTOGOLABRUS ADSPERSUS FOLLOWING EXPOSURE TO CRUDE OIL,

Dept. of Fisheries and Oceans, P.O. Box 5667, St. John's, Newfoundland, Canada A1C 5X1.
U. P. Williams, and J. W. Kiceniuk.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 6, p 1044-1048, June 1987. 1 fig, 13 ref.

Descriptors: *Water pollution effects, *Cunner, *Food habits, *Oil spills, Productivity, Growth, Population exposure, Feeding rate, Fish behavior.

Cunners (Tautogolabrus adspersus) are found throughout the year in inshore Newfoundland waters in depths of less than 10 m. This species is a bottom dweller and is commonly found around rocks, wharves, ledges and other areas where shelter is readily available. This species' inshore habitat and non-migratory habit make it potentially susceptible to a pollutant such as oil. This study was initiated to determine the time course of the onset of feeding reduction and recovery under environmentally realistic conditions experienced during an oil spill. Productivity of a fish stock is an important consideration and is the product of the number of individuals in that stock as well as their growth rates. Growth rate in fish is largely determined by food intake and any factor which affects this will be detrimental to the overall productivity of that stock. Exposure of fish to relatively high concentrations of oil can result in a number of diverse and deleterious biological changes, one result of which is a depression of feeding. This study shows that a concentration in the 150-250 microgram/L range for 4-5 weeks is required for the onset of feeding depression and recovery can occur in as few as 2-3 weeks. A particular population of cunners would have to be exposed to relatively high concentrations of oil for a prolonged period of time while they are actively feeding, before there would be an effect on the productivity of that population. (Alexander-PTT)
W87-09239

TOXICITY AND BIOACCUMULATION OF CADMIUM IN EXPERIMENTAL CULTURES OF DUCKWEED, LEMNA POLYRRHIZA L.,

Dept. of Botany, UER Pharmacy of Rouen, 76800 Saint Etienne du Rouvray, France.
S. Charpentier, J. Garnier, and R. Flaugnatti.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 6, p 1055-1061, June 1987. 8 fig, 3 tab, 4 ref.

Descriptors: *Water pollution effects, *Path of pollutants, *Cadmium, *Duckweed, Cultures, Aquatic weeds, Heavy metals, Toxicity, Growth, Nutrients.

The effects on duckweed of cadmium chloride (CdCl2-2.5 H20) and cadmium sulfate (3Cd S04-8H20) were compared. The toxicity effect was approached by the numeration of plants and determination of different data: The concentration causing 50% decrease of plant multiplication and growth: multiplication and growth E.C. 50 (effective concentration 50). The concentration for which 50% of the population is morbid (morbidity concentration 50 = MC 50). Stimulation of growth were observed for 0.02 mg/l and multiplication stimulation up to 0.1 mg/l. High concentrations entailed a fast decrease of the healthy population whereas the impact on the total population was not obvious. Multiplication EC 50 were much higher than growth EC 50. In another way, controls showed a linear growth of populations during the 14 days experiment. So the plants did not suffer any nutritional diseases and observed effects were only caused by toxic compounds added to the nutritive solutions. These results demonstrate that in Lemna polyrrhiza L, the roots are the principal Cd absorption organelle and accumulation site of the plants. This duckweed behaves towards toxic compounds like unicellular algae used in aquatic tests and can bring numerous information in such a test. Nevertheless Lemnaceae are higher plants and these results are more typical of common flora. So this experimental material should be useful in a battery of shorts tests concerning the behavior of toxic compounds at different stages of aquatic ecosystems. (Alexander-PTT)
W87-09241

INFLUENCE OF LIGHT ON CHLOROPHYLL, A CONTENT OF BLUE-GREEN ALGAE TREATED WITH HEAVY METALS,

School of Environmental Sciences, Jawaharlal Nehru Univ., New Delhi-110 067, India.
P. A. Azeez, and D. K. Banerjee.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 6, p 1062-1069, June 1987. 1 tab, 12 ref.

Descriptors: *Chlorophyll a, *Water pollution effects, *Cyanophyta, *Light effects, *Heavy metals, Toxicity, Population exposure, Algae.

The present study was undertaken to explore the effect of light on the chlorophyll A (Chl A) content of blue green algae. This is in continuation of heavy metal toxicity and accumulation studies on cyanobacteria reported earlier by the present authors. The unicellular species Anacystis contains more Chl A than the filamentous Spirulina. It was observed that the Chl A contents of these two species were 0.74 + or - 0.02% and 0.42 + or - 0.01% of the total dry weight respectively. Exposure of the algae to the metals for 6 hrs reduced the Chl A content. This reduction in Chl A content varied with the metal and also with the experimental species. The decrease in Chl A content when Anacystis and Spirulina were treated with Cu and Cd has been reported earlier by the present workers. When Anacystis was treated with the metals, under illuminated conditions, 10.0 ppm Cu resulted in the highest reduction in Chl A content. In terms of percent reduction it was 40.5%. The same treatment under dark conditions resulted in the reduction of Chl A content by 24.2%. In case of Spirulina the highest reduction in Chl A content was observed when treated with 10.0 ppm Ni. In this case, Chl A content was reduced by 57.4% and 52.7% under light and dark conditions respectively. The decrease in Chl A content in the presence of Cu, Cd, Ni and Cr followed the general relation, Chl A = K + nln C (C = concentration of metal in ppm; K and n = intercept and slope respectively). (Alexander-PTT)
W87-09242

ZINC, IRON, MANGANESE, AND MAGNESIUM ACCUMULATION IN CRAYFISH POPULATIONS NEAR COPPER - NICKEL SMELTERS AT SUDBURY, ONTARIO, CANADA,

Dept. of Biology, Laurentian Univ., Sudbury, Ontario P3E 2C6, Canada.
G. Bagatto, and M. A. Alikhan.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 38, No. 6, p 1076-1081, June 1987. 4 tab, 18 ref. NSERC (Canada) Grant A3149.

Descriptors: *Water pollution effects, *Path of pollutants, *Bioaccumulation, *Heavy metals, *Crayfish, *Smelters, Zinc, Iron, Manganese, Copper, Nickel, Tissue analysis, Lakes.

The present study compares concentrations of zinc (Zn), iron (Fe), manganese (Mn) and magnesium (Mg) in freshwater crayfish at selected distances of the habitat from the emission source. These metals were selected since they are known to be emitted in moderately high quantities into the Sudbury environment as byproduct of the smelting process. Various tissue concentrations in crayfish were also examined to determine specific tissue sites for these accumulations. In general, highest tissue Zn and Fe concentrations were observed in crayfish obtained from Ramsey Lake and lowest from those collected from Wizard Lake. Tissue concentrations of Mg were highest in animals from Joe and Wizard Lakes and lowest in crayfish from Ramsey Lake. Mn levels were highest in crayfish obtained from Joe Lake and lowest in those captured from Wizard Lake. The distribution of each metal in crayfish tissues was not identical. Zn concentrations were highest in the hepatopancreas and digestive gut and lowest in the exoskeleton. (Alexander-PTT)
W87-09243

SAFETY FACTOR FOR LC50 VALUES ALLOWING FOR DIFFERENCES IN SENSITIVITY AMONG SPECIES,

Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Delft (Netherlands).
S. A. L. M. Kooijman.
Water Research WATRAG, Vol. 21, No. 3, p 269-276, March 1987. 8 fig, 2 tab, 8 ref.

Descriptors: *Data interpretation, *Water pollution effects, *Toxicity, Sensitivity, Safety factors, Probabilistic process, Cost-benefit analysis.

A safety factor has been derived that can be applied to the mean LC50 value of several test species for a particular toxic compound, for the purpose of arriving at what has been called a hazardous concentration for sensitive species. The application of this factor should provide limited protection to a certain number of species in a relevant community. The derivation is based on the assumption that the LC50 values for both the test species and for the community species can be conceived of as independent random trials from a log-logistic distribution. The proposed hazardous concentration for sensitive species has been chosen such that the LC50 value of the most sensitive species in a community of a certain number of species exceeds that concentration by a specified probability. It allows for the uncertainty in the mean and variance of the LC50 values for the test species that is

due to the number of test species being limited. It is possible to calculate the optimum number of species to be tested on basis of a cost-benefit analysis. Examples of the application are given. (Author's abstract)
W87-09266

COMPARISON OF TOXICITY TESTS CONDUCTED IN THE LABORATORY AND IN EXPERIMENTAL PONDS USING CADMIUM AND THE FATHEAD MINNOW (PIMEPHALES PROMELAS),
Cornell Univ., Ithaca, NY. Dept. of Natural Resources.
R. E. Sherman, S. P. Gloss, and L. W. Lion.
Water Research WATRAG, Vol. 21, No. 3, p 317-323, March 1987. 3 fig, 5 tab, 25 ref.

Descriptors: *Bioassay, *Water pollution effects, *Ponds, *Cadmium, *Minnows, Toxicity, Comparison studies, Field tests, Survival.

Acute toxicity tests were conducted in the laboratory with fathead minnows (Pimephales promelas) to determine the 96-h LC50 of cadmium under three conditions: (1) in laboratory water, (2) in water from experimental ponds, and (3) in pond water underlain by sediment. Cadmium was then applied at doses equivalent to the estimated LC50 values to 0.07-ha ponds containing caged fathead minnows. A cadmium ion selective electrode, ultrafiltration, and equilibrium calculations were used to determine cadmium speciation, and several water quality characteristics were measured to correlate differences in mortality between test systems (laboratory and field) with observed differences in water quality. The LC50 estimates (mg/l) for the bioassays were 4.39 for the laboratory water, 3.52 for the pond water with sediment, and 2.91 for the pond water. Concentrations of Cd(2+) decreased and those of cadmium in the particulate (> 1.2 micron) and 300,000 mol. wt. (0.018-1.2 micron) fractions increased over the 96-h; cadmium in these fractions was believed to consist of colloidal sized CdCO3 precipitates. Concentrations of Cd(2+) decreased at different rates between test systems, regulated by the degree of CdCO3(s) supersaturation which in turn depended on pH and total metal concentrations. Differences in toxicity in the laboratory tests were attributed to differences in water hardness and Cd(2+) concentrations. Mortality of fathead minnows was low (0-10%) during the 96-h test period in the ponds due to the higher pH, which produced supersaturated conditions resulting in the rapid formation of nontoxic CdCO3 precipitates and a more rapid decrease in Cd(2+) concentrations as compared to the laboratory bioassays. (Author's abstract)
W87-09272

METHANOGENIC TOXICITY AND ANAEROBIC DEGRADABILITY OF A HYDROLYZABLE TANNIN,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
For primary bibliographic entry see Field 5D.
W87-09278

FUNDAMENTALS OF AQUATIC TOXICOLOGY: METHODS AND APPLICATIONS.
FMC Corp., Princeton, NJ.
Hemisphere Publishing Corporation, Washington, DC. 1985. 666 p. Edited by Gary M. Rand and Sam R. Petrocelli.

Descriptors: *Path of pollutants, *Aquatic toxicology, *Water pollution effects, *Toxicity, *Fate of pollutants, Sublethal effects, Pollution load, Pesticides, Metals, Distribution, Aquatic environment, Hazard assessment, Legal aspects, Legislation.

This book presents a definitive description of basic concepts and test methods employed in aquatic toxicology studies as well as examples of typical data and their interpretation. The 23 chapters are divided into five parts. The first part - Toxicity Testing - describes the basic concepts and methodologies used in aquatic toxicity testing. Sublethal Effects, the second part, presents information on sublethal effects testing and its utility in evaluating the less obvious effects of chemical exposure summarizes the available literature on the toxicity of generic types of Effects - summarizes the available literature on the toxicity of generic typ Distribution/Fate, the fourth part, discusses the various factors that affect the distribution and fate of chemicals in the aquatic environment and thus influence the chemical concentrations to which aquatic organisms may be exposed. The concluding fifth part - Hazard Evaluation - discusses the manner in which environmental fate and biological effects data are integrated to provide an assessment of the potential hazard posed by the use or discharge of chemicals in the aquatic environment. It also identifies the specific laws that provide regulatory agencies with enforcement powers to control discharges into the aquatic environment. Since aquatic toxicology is a specialized discipline, with its own terminology, a glossary of the most commonly used terms is included. (See W87-09281 through W87-09302) (Lantz-PTT)
W87-09280

ACUTE TOXICITY TESTS,
P. R. Parrish.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 31-57, 7 fig, 7 tab, 54 ref.

Descriptors: *Toxicity, *Water pollution effects, *Acute toxicity tests, *Testing procedures, Invertebrates, Phytoplankton, Fish, Data interpretation, Sensitivity analysis.

Acute toxicity tests constitute only one of the many tools available to the aquatic toxicologist, but they are the basic means of providing a quick, relatively inexpensive, and reproducible estimate of the toxic effects of a test material. They are an indispensable 'first-look' method, at least at this point in the development of the science of aquatic toxicology. Acute tests are also useful in screening large numbers of chemicals and in evaluating the relative sensitivity of different organisms to the same chemical. Thus they have been highly rated in 'their present utility for use in assessing the hazard to aquatic environments.' Methodologies for fish, invertebrate and phytoplankton toxicity testing are discussed, with emphasis on: static acute tests, flow-through acute tests, experimental design, test procedures, and data analysis and interpretation. There are limitations of acute tests that should be recognized. The results of acute toxicity tests usually do not provide substantive information about the sublethal or cumulative effects of a test material. Furthermore, these tests are not preductive of potential chronic toxicity. These limitations should be considered when planning testing programs for specific test materials. (See also W87-09280) (Lantz-PTT)
W87-09281

EARLY LIFE STAGE TOXICITY TESTS,
Environmental Research Lab.-Duluth, MN.
J. M. McKim.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 58-95, 20 fig, 7 tab, 131 ref.

Descriptors: *Toxicity, *Aquatic toxicity, *Water pollution effects, *Life cycles, *Testing procedures, Fish, Aquatic environment, Invertebrates, Daphnia, Organic compounds, Inorganic compounds, Environmental effects.

A life cycle test demands a minimum laboratory exposure of the animal from 'embryo to embryo,' which for many animals, especially vertebrates (fish), requires a minimum of 6-12 mo of concentrated effort. The Toxic Substances Control Act of 1976, which required the Environmental Protection Agency (EPA) and industry to evalute the environmental impact of new chemicals before commercial production, and the manufacture or marketing of an estimtaed 1000 new chemicals each year created the need for a more rapid, less costly, and less risky vertebrate test than the fish life cycle test for detrmining safe environmental concentrations of toxic chemicals. During life cycle tests with several species of fish and a variety of toxicants, certain developmental stages have consistently been more sensitive than others. The possibility of focusing research efforts on these more sensitive stages promises success in searching for quicker and less costly ways of predicting chronic toxicity of chemicals to fish. Several investigators proposed that chronic toxicity to fish might be predicted by use of shorter tests with early developmental stages. In studies with selected toxicants, these early stages were shown to be among the most sensitive in the life cycle. It was emphasized that, with a relatively short exposure (several months) of the embryo-larval and early juvenile stages of fish to a toxicant, an estimate of the maximum acceptable toxicant concentration (MATC) could be obtained without a complete life cycle test. The need for toxicity tests of short duration was not as great for the mroe routinely testesd invertebrates (daphnids and mysids), since msot invertebrate life cycle tests require only 1-2 mo. Shorter, partial life cycle tests with certain invertebrates have, in some cases, resulted in less sensitive responses than the complete life cycle or lifetime test. Reviews of life cycle toxicity test data on freshwater fish, from more than 60 chronic test with more than 40 organic and inorganic chemicals, show that tests with early life stages of four species of fish can be used to estimate the MATC within a factor of 2 in most cases. This chapter provides more details on terminology, fish developmental events, end points used in determining effects, general methodologies employed, and the interpretation and utility of early life stage (ELS) tests with aquatic animals. (See also W87-09280) (Lantz-PTT)
W87-09282

CHRONIC TOXICITY TESTS,
Battelle New England Marine Research Lab., Duxbury, MA.
S. R. Petrocelli.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 96-109, 2 tab, 39 ref.

Descriptors: *Toxicity, *Aquatic toxicity, *Water pollution effects, *Chronic toxicity, Testing procedures, Life cycles, Larvae, Embryos, Mathematical analysis, Lethal limits, Aquatic environment.

A chronic toxicity test is designed to expose all life stages of the test animal - viable gametes, newly fertilized ova, early stages of developing embryos, or newly hatched larvae - to a range of chemical concentrations estimated (from acute toxicity test exposures) to bracket the threshold for significant deleterious effects. If appropriate test concentrations have been selected, the populations exposed to the higher concentrations in this test will be adversely affected, as judged by standard criteria, while those exposed to the lower concentrations will not be adversely affected as compared with unexposed populations (controls). The threshold concentration that produces statistically significant deleterious effects is commonly expressed as the maximum acceptable toxicity concentration (MATC). The MATC is a hypothetical concentration and is in a range bounded at the lower end by the highest concentration in the chronic test that produced no effect (NOEC, no observed effect concentration) and at the higher end by the lowest concentration tested that produced a statistically significant effect (LOEC, lowest observed effect concentration). Therefore the MATC can be represented as NOEC < MATC < LOEC. In attempting to relate the acute toxicity and chronic toxicity of chemicals to aquatic organisms, the application factor (AF) concept was proposed. The AF is a unitless, chemical-specific measure calculated as the threshold chronically toxic concentration of a chemical divided by its acutely toxic concentration. In practice, the AF is calculated by dividing the limts (NOEC and LOEC) of the MATC by the time-independent or incipient LC50 or, if that value is not available, by the 96-h LC50 from a flow-through acute toxicity test. In concept, the AF would be relatively constant for a specific chemical. Thus, if the AF for a chemical was empirically determined with one aquatic species, it could be applied to other aquatic species. In

some cases, the AF was used to provide an estimate of chronic toxicity without a chronic test, even if the test was possible with that species. This saved the time and costs associated with the chronic test. The investigator would estimate the AF for a chemical with one organism and then apply the AF to the acutely toxic concentration for the second organism. (See also W87-09280) (Lantz-PTT)
W87-09283

STATISTICAL ANALYSIS,
Harvard Univ. School of Public Health, Boston, MA. Dana Farber Cancer Inst.
R. D. Gelber, P. T. Lavin, C. R. Mehta, and D. A. Schoenfeld.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 110-123, 2 tab, 27 ref. NCI, DHHS and Mellon Foundation Grant CA-23415, CA-06516, and CA-33019.

Descriptors: *Water pollution effects, *Statistical analysis, *Toxicity, Lethal limit, Data interpretation, Statistical methods, Regression analysis, Acute effects, Chronic effects.

Current practices for the analysis of data from acute and chronic tests are presented and critically evaluated. For the acute test, most methods currently used yield comparable estimates for the LC50. The probit method is optimal when the tolerances to log concentrations of the toxicant are normally distributed. For the chronic test, the current practice of performing an F-test among all concentrations, followed by Dunnett's procedure, is statistically inefficient for a variety of reasons. It does not allow for data pooling or exploitation of the expected concentration-response relationship. It can lead to misleading situations where the global F-test is significant while Dunnett's procedures do not identify any significant control-concentration differences. Existing statistical procedures, namely those for data pooling and isotonic regression, provide the toxicologist with improved procedures for MATC determination. (See also W87-09280) (Lantz-PTT)
W87-09284

FACTORS THAT MODIFY TOXICITY,
Guelph Univ. (Ontario). Dept. of Zoology.
J. B. Sprague.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 124-163, 7 fig, 8 tab, 181 ref.

Descriptors: *Toxicity, *Water pollution effects, *Aquatic toxicity, Variability, Water temperature, Lethal limits, Life cycles, Dissolved oxygen, Hydrogen ion concentration, Heavy metals, Environmental effects, Aquatic environment.

Factors that modify the toxicity of pollutants to aquatic organisms, including biotic variables such as species and abiotic variables such as water temperature, have been considered in this chapter. Effects of modifying factors must be cautiously interpreted within experiments and not between them, bearing in mind that even repeated toxicity tests in the same laboratory will not give identical results. A careful investigator may obtain a series of LC50s with a range of only + or - 20% of the median value. If good basic procedures are followed in acute lethality tests, other differences in test procedure do not affect results greatly. The kind of test organisms has a major influence on toxicity data, but perhaps less than might be expected. A literature review with individual comparisons of 15 pollutants tested under similar conditions, with results accepted for all types of organisms, showed that well over half of the lethal levels fell within one order of magnitude. In the life cycle of fish, the egg, larval, and early juvenile stages are most sensitive in chronic exposures. There is only slim evidence that diseased stocks of fish are less tolerant of toxicants. There is no general effect of temperature on toxicity. Dissolved oxygen concentrations in the vicinity of 20-30% of saturation seem to cause an increase of only about 1.5-fold in lethality of toxicants to fish. Some pollutants show large changes in toxicity with pH of the water if they are ionized under the influence of that variable. Usually it is the undissociated or less dissociated form that is most toxic, and the change may be an order of magnitude for a difference of one per unit or less. Salinity is a major variable among the characteristics of surface water, but its influence on toxicity is not so important. Many heavy metals become an order of magnitude more lethal in very soft water than in very hard water, and sublethal changes are roughly parallel. Natural waters often contain suspended and dissolved matter including organic ligans or chelators. Metals are the chief examples of pollutants that may be detoxified because of sorption or binding by these materials; most other pollutants seem much less affected. Among the metals copper is particularly affected, and binding and sorption may decrease its lethal and sublethal toxic effects by an order of magnitude. (See also W87-09280) (Lantz-PTT)
W87-09285

TOXICITY OF CHEMICAL MIXTURES,
National Fishery Research Lab., La Crosse, WI.
L. L. Marking.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 164-176, 2 fig, 3 tab, 67 ref.

Descriptors: *Aquatic toxicity, *Water pollution effects, *Chemical composition, *Synergistic effects, *Toxicity, Hazard assessment, Environmental effects, Acute effects, Antagonistic effects, Quantitative analysis.

Assessment of mixture toxicity began as an art, but it has developed into a science used in many disciplines: pharmacology, toxicology, physiology, human and veterinary medicine, agriculture, and especially pest control. Application of mixtures of chemicals has become popular because of their purported advantages over a single chemica. However, some chemical mmixtures pose a greater hazard to nontarget organisms and to the environment. The advantages and disadvantages of using mixtures can be determined only by understanding the concepts to mixture toxicity and developing the ability to calculate quantitatively the additive toxicity of mixtures of chemicals. Investigators in various disciplines have attempted to describe synergism and antagonism; the result has been ambiguous terminology, even though the methodology has been fairly consistent. A number of additive toxicity procedures appear in the literature, but only a few are truly quantitative, and perhaps there is no one procedure that will accomodate all types of multiple exposures. Use of the additive toxicity index was developed from isobole theory and the summation of toxic units, as were many other methods. However, the index system has the advantages that (1) index values are linear for greater than and less than additive toxicity, (2) the significance of index values can be assessed to differentiate between the three categories of additive toxicity, and (3) magnification factors can be calculated to describe and express the expected activity or changes in unexpected activity. Furthermore, ranges for index values that overlap zero indicate additive toxicity, positive values indicate greater than additive toxicity, and negative values indicate less than additive toxicity. Synergism and antagonism are general terms and their use must be based on quantitative data. Both phenomena result from the summation of toxic units from multiple chemicals in the environment. (See also W87-09280) (Lantz-PTT)
W87-09286

MICROBIAL TOXICITY STUDIES,
Environmental Research Lab., Gulf Breeze, FL.
P. H. Pritchard, and A. W. Bourquin.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 177-217, 19 fig, 11 tab, 61 ref.

Descriptors: *Microbiological studies, *Aquatic toxicity, *Water pollution effects, *Toxicity, Chlorinated hydrocarbons, Biodegradation, Bacteria, Fungi, Nitrification, Photosynthesis, Ecosystems, Ecological effects.

Microorganisms are an integral part of the nutrient cycling and energy flow processes of aquatic ecosystems. Their degradative and mineralization capabilities maintain the carbon balance of the ecosystem and also permit humans to dispose of synthetic wastes in aquatic environments. These environments have a certain assimilatory capacity for the wastes, and their biodegradation potential determines the magnitude of this capacity. Humans must not exceed this capacity. The generation of persistent or nonbiodegradable chemicals show how easily this capacity can be abused. The input of chlorinated hydrocarbons into the environment exceeded their biological detoxification, and major ecological damage resulted. Had the assimilatory capacity been properly assessed, environmental abuse might have been avoided. The toxicity of chemicals to bacteria must be carefully observed and researched. If a new synthetic chemical is developed and allowed to pollute the environment, some microbial processes could be disturbed, and this could eventually have an indirect but catastrophic effect on the entire ecosystem. Severe inhibition of nitrification can affect plant communities. If photosynthetic production drops, the effect ripples throughout the ecosystem. Bacteria and fungi and the processes they catalyze are fairly resistant to inhibition by synthetic chemicals. A small perturbation in one part of the environment can often be overcome because of the ubiquity of microorganisms and their great metabolic diversity. Nonetheless, toxicologists should incorporate microorganisms into testing schemes, since they may be potential indicators of environmental damage. The importance of using a wide diversity of toxicity tests for microorganisms cannot be overemphasized. Rapid methods for assessing chemical toxicity to microorganisms are needed for detecting chemicals that are potentially toxic to the ecosystem. Continued research in basic microbial ecology should help fill this need. (See also W87-09820) (Lantz-PTT)
W87-09287

BEHAVIOR,
FMC Corp., Princeton, NJ.
G. M. Rand.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 221-263, 15 fig, 2 tab, 184 ref.

Descriptors: *Behavior, *Water pollution effects, *Chemical pollutants, *Toxicity, Aquatic toxicology, Monitoring, Feeding rates, Sublethal effects, Stress, Life cycles, Aquatic environment.

A behavioral response may be the initial reaction to chemical exposure in the natural environment. A chemical may be detected and avoided or may produce deleterious behavioral effects. Although there are currently no standard behavioral testing techniques in aquatic toxicology, several considerations for testing have been discussed and many of the monitoring techniques presented. The literature on several types of behavior (e.g., locomotor, feeding, predator-prey, learning) has been evaluted and the advantages and disadvantages of behavioral testing discussed. Several behaviors are promising indicators of sublethal stress of aquatic organisms exposed to chemical agents. However, in a behavioral testing program normal baseline behavioral data must first be obtained and then toxicity testing can be initiated. Several different types of behavioral tests should be conducted with different test species and may include different life stages. (See also W87-09280) (Lantz-PTT)
W87-09288

BIOCHEMISTRY/PHYSIOLOGY,
Columbia National Fisheries Research Lab., MO.
P. M. Mehrle, and F. L. Mayer.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 264-282, 2 tab, 38 ref.

Descriptors: *Water pollution effets, *Physiological studies, *Biochemical analysis, *Toxicity,

Aquatic environment, Aquatic toxicology, Monitoring, Hazard assessment, Environmental effects.

Physiological and biochemical measurements have not been as integral a part of aquatic toxicology as they have been of mammalian toxicology. However, they are attracting more interest as aquatic toxicologists find a need for short-term tests that predict long-term toxicity, because the number of toxic chemicals and the cost of conducting chronic toxicity studies are increasing. Although they will not replace acute or chronic toxicity tests that determine effects on survival, growth, and reproduction in the laboratory, physiological and biochemical measurements (such as: mean blood chemistry values, toxicant effects on bone development and growth in fish, lead inhibition of aminolevulinic acid dehydrotase activity, respiration and oxygen consumption, osmoregulation, and gill adenosinetriphosphotase) will be useful in setting priorities for determining the chemicals for which more comprehensive hazard assessment is needed. They will also be useful in field investigations to detremine the toxicological significance of contaminant residues in wild fish populations. Aquatic toxicologists need better diagnostic tools in order to better understand the impact of chemicals on fish and other aquatic organisms. The examples discussed here show that physiological and biochemical approaches will help to satisfy this need. Underlying the efforts to develop diagnostic tools is the need to plan and execute the biochemical and physiological research within the framework of what exists in the real world. Unless the status of the environment we are attempting to preserve and improve is kept in proper perspective, much of the effort willbe of little or no avail. Consequently, continued reassessment of aquatic toxicology in relation to the continued change in environmental needs is mandatory if the obvious objectives are to be reached. Yet the need for basic information must not be forgotten when research programs are designed, especially with aquatic organisms, for this information is ultimately the foundation for applied research. (See also W87-09280) (Lantz-PTT)
W87-09289

HISTOPATHOLOGY,
Alaska Univ., Juneau. School of Fisheries and Science.
T. R. Meyers, and J. D. Hendricks.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 283-331, 15 fig, 2 tab, 206 ref.

Descriptors: *Histopathology, *Water pollution effects, *Aquatic toxicology, *Tissue analysis, Toxicity, Aquatic environment, Monitoring, Biochemical analysis, Transmission electron microscopy, Scanning electron microscopy, Pathological effects.

The far-reaching pathological effects of chemical pollution are often very difficult to define in populations of aquatic species. This is particularly true of subtle changes that occur over long periods of exposure to intermitttent or continuous sublethal doses of one or several toxicants. The many disciplines in the science of aquatic toxicology are joined in the task of identifying and comprehending each toxicant's mode of acitivity in organisms which is responsible for clinical signs of intoxication or death. This can be discerned to some degree through biochemical and physiological studies. However, effects are often due to physical changes in the tissues at the cellular or ultrastructural levels and can only be speculated upon unless they are visualized. Since these changes are not grossly apparent, histopathological studies with light microscopy, TEM, and SEM are necessary for the description and evaluation of potential lesions in aquatic animals exposed to various toxicants. Although many toxicant-induced tissue pathologies so far examined have been nonspecific, this is not surprising since aquatic toxopathology is in its infancy. As the science matures and more descriptive studies are made, lesions should emerge which will allow greater specificity in diagnosing exposure to certain groups of compounds or perhaps to single toxicants. By combining histopathological results with results of biochemical and physiological studies, the complete reaction of an aquatic organism to a toxicant may be defined for future diagnostic purposes. (See also W87-09280) (Lantz-PTT)
W87-09290

PESTICIDES,
Colorado State Univ., Fort Collins. Dept. of Fishery and Wildlife Biology.
D. R. Nimmo.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 335-373, 1 fig, 18 tab, 183 ref.

Descriptors: *Toxicity, *Pesticides, *Aquatic toxicology, *Water pollution effects, *Fate of pollutants, Organic compounds, Testing procedures, Temperature, Hydrogen ion concentration, Photosensitivity, Sublethal limits, Monitoring.

Synthetic organic compounds are likely to continue to be used against a variety of pests, and recent trends indicate that widespread use of organochlorin-type chemicals will diminish. A variety of newer chemical types with different and unique modes of action will probably become available. Current pest control methods tend to involve use of several different chemicals mixed in varying proportions. Infestations of pests (e.g., the Mediterranean fruit fly) that threaten an entire region or a major crop will probably still be controlled with well-known chemicals, but wide applciation of a single pesticide will probably diminish. Methods of assessing impacts of chemicals are evolving from single toxicity tests to the integration of many factors discussed in this chapter (such as the physical-chemical behavior of the compound). Toxicity tests will continue to be a vital part of the evalution process, as for routine screening, but the cheklist of factors necessary for substantiation of the impact continues to grow. Temperature, pH, photosensitivity, method of application, rates of metabolism, and many other factors will become increasingly important in the consideration of 'hazard' or 'impact.' In toxicity testing of pesticides, there appears to be a trend toward longer-term tests and towaard investigation of sublethal effects. Emphasis is also being placed on problems associated with extrapolation of laboratory results to conditions in the field (validation) and use of microcosms to evaluate new chemicals before production. (See also W87-09280) (Lantz-PTT)
W87-09291

TRACE METALS,
Geological Survey, Menlo Park, CA.
H. V. Leland, and J. S. Kuwabara.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 374-415, 4 fig, 4 tab, 294 ref.

Descriptors: *Trace metals, *Toxicity, *Water pollution effects, *Aquatic toxicology, Cobalt, Copper, Chromium, Iron, Manganese, Nickel, Molybdenum, Selenium, Tin, Zinc, Sublethal limits, Heavy metals, Toxicity, Aquatic environment, Lethal limits.

Many trace metals are important in plant and animal nutrition, where, as micronutrients, they play an essential role in tissue metabolism and growth. The essential trace metals include cobalt, copper, chromium, iron, manganeses, nickel, molybdenum, selenium, tin, and zinc. Requirements of different plant and animal species vary substantially, but optimal concentration rangtes for micronutrients are frequently narrow. Severe imbalances can cause death, wherease marginal imbalances contribute to poor health and retarded growth. Some nonessential trace metals, such as lead, cadmium, and mercury, also can be toxic at concentrations commonly observed in soils and natural waters. Adverse environmental effects associated with redistribution of trace metals, such as by mining and fossil fuel combustion, have long been recognized. Recent efforts to document and control the environmental distribution of potentially hazardous trace metals have led to a large body of literature on biological effects of metals in aquatic environments. Much of this literature considers lethal, solution concentrations for individual species, or trace metal bioavailability and body burdens of common or commercially important species. Recent reviews of these topics are referenced in the text. This paper focuses on the toxicology of trace metals and the responses of aquatic organisms to metal exposure. (See also W87-09280) (Lantz-PTT)
W87-09292

POLYCYCLIC AROMATIC HYDROCARBONS,
Battelle New England Marine Research Lab., Duxbury, MA. William F. Clapp Labs.
J. M. Neff.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 416-454, 2 fig, 7 tab, 140 ref.

Descriptors: *Toxicity, *Water pollution effects, *Aromatic hydrocarbons, *Aquatic toxicology, *Water pollution sources, Organic compounds, Oil spills, Environmental effects, Aquatic environment, Ash, Marine environment.

Polycyclic aromatic hydrocarbons (PAH) constitute one of several classes of organic pollutants that are released into the environment in large quantities due in large part to human activities. PAH are components of crude and refined petroleum and of coal. Oil spills are a major source of PAH in freshwater and marine environments. Combustion of organic materials in fires or in internal combustion engines produces PAH which are released to the environment in exhaust particulates and in solid residues (ash). Concern about PAH in the environment arises from the fact that many of them are quite persistent and some are known to be potent carcinogens in mammals. The environmental effects of most of the PAH that are not carcinogenic are poorly understood. The purpose of this review is to summarize and synthesize what is known about the impact of PAH on aquatic organisms and ecosystems. (See also W87-09280) (Lantz-PTT)
W87-09293

AMMONIA, NITRITE, AND NITRATE,
Montana State Univ., Bozeman. Fisheries Bioassay Lab.
R. C. Russo.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 455-471, 4 fig, 3 tab, 92 ref.

Descriptors: *Ammonia, *Nitrites, *Nitrates, *Water pollution effects, *Aquatic toxicology, *Toxicity, Nitrogen compounds, Hydrogen ion concentration, Dissolved oxygen, Temperature, Salinity, Chlorides, Calcium, Acute effects.

Ammonia (NH_3) is one of the most important pollutants in the aquatic environment because of its relatively highly toxic nature and its ubiquity in surface water systems. It is discharged in large quantities in industrial, municipal, and agricultural waste waters. Nitrite (NO_2^-) isnot considered such a severe environmental problem becuase, although it is extremely toxic to aquatic life, it does not usually occur in natural surface water systems at concentrations considered deleterious to aquatic organisms. Nitrate (NO_3^-) is a less serious environmental problem; it can be found in relatively high concentrations in surface waters, but is relatively nontoxic to aquatic organisms. Acute toxicity of ammonia to aquatic organisms is affected by water pH, dissolved oxygen, temperature, fluctuating concentrations, previous acclimation to ammonia, calcium, salinity, and the presence of other chemicals. Whether these factors also affect chronic toxicity has not yet been investigated. Acute toxicity of nitrite is affected by water pH, chloride, and calcium. More research is needed on the effects on toxicity of other water chemistry variables and on long-term effects of nitrite exposure. (See also W87-09280) (Lantz-PTT)
W87-09294

BIOACCUMULATION,
Purdue Univ., West Lafayette, IN. Dept. of Forestry and Natural Resources.
For primary bibliographic entry see Field 5B.
W87-09296

BIOTRANSFORMATION,
The Medical Coll. of Wisconsin, Milwaukee. Dept. of Pharmacology and Toxicology.
For primary bibliographic entry see Field 5B.
W87-09297

FATE MODELING,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 5B.
W87-09298

ENVIRONMENTAL LEGISLATION,
Springborn Bionomics, Inc., Wareham, MA. Aquatic Toxicology Lab.
For primary bibliographic entry see Field 6E.
W87-09299

FIELD VALIDATION,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 7A.
W87-09300

CHEMICAL SAFETY EVALUATION,
Exxon Corp., East Millstone, NJ. Medical Dept.
For primary bibliographic entry see Field 5B.
W87-09301

RESPONSE OF MARINE ANIMALS TO PETROLEUM AND SPECIFIC PETROLEUM HYDROCARBONS,
Battelle New England Marine Research Lab., Duxbury, MA.
J. M. Neff, and J. W. Anderson.
Applied Science Publishers Ltd., London, England. 1981. 177 p.

Descriptors: *Oil spills, *Path of pollutants, *Fate of pollutants, *Water pollution effects, *Hydrocarbons, *Toxicity, Marine environment, Environmental effects, Sublethal limits, Marine biology.

During the past decade, a very large volume of research has been performed dealing with the fate and effects of petroleum in the marine environment. Major interest in and financial support for research in this area followed the wreck of the tanker 'Torrey Canyon' off Cornwall, Great Britain on 18 March 1967 and the smaller oil spill resulting from the wreck of the oil barge 'Florida' off Falmouth, Massachusetts on 16 September 1969. Both psills were near major marine research laboratories and both were studied intensively by leading marine scientists. From these investigations has come the increased realization that deleterious impacts of oil on the marine ecosystem may persist long after the visible oil pollution has been cleaned up or washed away. In the decade since these spills, the volume of petroleum transported by sea has increased substantially and there has been a large increase in exploration for and production of offshore oil deposits. Between 1972 and 1977 extensive laboratory and field research dealing the toxicity and sublethal biological effects of petroleum to marine organisms has been conducted. The purpose of this book is to summarize and review lethal and sublethal effects of oil on marine organisms, based on results of these laboratory studies. (Lantz-PTT)
W87-09308

SEPTIC TANK SYSTEM EFFECTS ON GROUND WATER QUALITY,
Oklahoma Univ., Norman. Environmental and Ground Water Inst.
L. W. Canter, and R. C. Knox.
Lewis Publishers, Inc., Chelsea, MI. 1985. 336 p.

Descriptors: *Water pollution effects, *Path of pollutants, *Septic tanks, *Groundwater quality, *Groundwater pollution, Water quality control, Domestic wastes, Wastewater disposal, Fate of pollutants, Bacteria, Virusess, Phosphorus, Nitrogen, Chlorides, Metals, Pesticides, Inorganic compounds, Case studies.

Approximately 1/3 of all housing units in the United States dispose of domestic wastewater through septic tank systems, and about 25% of all new homes being constructed are including them. Septic tank systems have been frequently identified as sources of localized and regional groundwater pollution. Historical concerns have focused on bacterial and nitrate pollution; more recently, synthetic organic chemicals from septic tank cleaners have been identified. A key issue in siting new septic tank systems is related to evaluating their groundwater pollution potential in the locality. This book summarizes existing literature relative to the types and mechanisms of groundwater pollution from septic tank systems, and provides information on technical methodologies for evaluating the groundwaater pollution potential of such systems. The book is organized into five chapters, with Chapter 1 including background information on the historical and current usage of septic tank systems, and Chapter 5 summarizing the key points of the book. Chapter 2 is related to the engineering design, placement, and operation and maintenance procedures for these systems. Chapter 3 summarizes the types of pollutants and mechanisms of contamination via the unsaturated zone into the groundwater system. The transport and fate of bacteria and viruses in soils and groundwater are addressed along with inorganic contaminants such as phosphorus, nitrogen, chlorides, and metals, and contaminants such as cleaning agents and pesticides. Chapter 4 is focused on the evaluation of septic tank system effects on groundwater quality. Information on the Surface Impoundment Assessment methodology and the Soil-Waste Interaction Matrix methodology as applied to 13 septic tank system areas is described. (Lantz-PTT)
W87-09310

ECOLOGICAL ASSESSMENTS OF EFFLUENT IMPACTS ON COMMUNITIES OF INDIGENOUS AQUATIC ORGANISMS.
Ecological Consultants, Inc., Fort Collins, CO.
A Symposium Sponsored by ASTM Committee D-19 on Water, ASTM, Ft. Lauderdale, FL, 29-30 January 1979. ASTM Special Technical Publication 730, 1981. 333 p.

Descriptors: *Water pollution effects, *Environmental effects, *Aquatic toxicology, *Symposium, *Effluents, Biological analysis, Bioassays, Standing crops, Ecosystems, Ecological effects, Surface water.

Interest in environmental impact assessment has greatly increased in recent years. While significant advances have been made in bioassays, biomonitoring, and other toxicological measurements, advancements in the development of methodologies for assessment of effluent impacts on the biological integrity of receiving waters has lagged. The purpose of the symposium was to provide a forum for scientists engaged in the development and application of methods of evaluating the effects of effluents on the biological integrity of surface waters. Emphasis is placed on methods of evaluating the effects of effluents on standing crop, community structure, and community function. The call for papers emphasized the importance of the feasibility of application and the priority ordering of community parameters to be investigated within the constraints of available time, personnel, and budget. (See W87-09312 through W87-09328) (Lantz-PTT)
W87-09311

EVALUATION OF THE EFFECTS OF EFFLUENTS ON AQUATIC LIFE IN RECEIVING WATERS - AN OVERVIEW,
Environmental Monitoring and Support Lab.-Cincinnati, OH.
C. I. Weber.
IN: Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms, A Symposium Sponsored by ASTM Committee D-19, Ft. Lauderdale, FL, 29-30 January 1979. ASTM STP 730, 1981. p 3-13, 1 fig, 2 tab, 36 ref.

Descriptors: *Water pollution effects, *Aquatic environment, *Effluents, Monitoring, Evaluation, Toxicity, Sample collection, Sample preparation, Aquatic organisms, Standing crop, Chemical analysis, Ecosystems.

Federal water pollution control legislation strongly emphasizes the need to protect aquatic life from adverse effects of effluents. Effluent biomonitoring, therefore, plays an important role in the federal water pollution control program, and includes two basic functions: (1) measurement of the toxicity and biostimulatory properties of effluents, and (2) measurement of the effects on the biological integrity of receiving waters, which includes the abundance, species composition, metabolism, and condition of indigenous aquatic organisms. Standardized methods for sample collection and preparation are widely available. However, additional tools are urgently needed to assist biologists in sample analysis and data interpretation. The tools needed include species identification manuals, information on the life histories of aquatic organisms, and descriptive models with which to evaluate field data. The models would describe the standing crop, species composition, and community metabolism expected at a given sampling station in the absence of pollution, taking into account the season of the year, climate, ambient meteorological and hydrological conditions, water chemistry, and the nature of the substrate. Effective data interpretation also requires utilization of available parametric and nonparametric methods for statistical analyses of the field data in order to determine the significance of observed differences in the properties of aquatic communities at 'control' and 'polluted' sampling stations. (See also W87-09311) (Author's abstract)
W87-09312

ENVIRONMENTAL IMPACT ANALYSIS OF AQUATIC ECOSYSTEMS USING RATIONAL THRESHOLD VALUE METHODOLOGIES,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
E. E. Herricks, M. J. Sale, and E. D. Smith.
IN: Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms, A Symposium Sponsored by ASTM Committee D-19, Ft. Lauderdale, FL, 29-30 January 1979. ASTM STP 730, 1981. p 14-31, 5 fig, 2 tab, 37 ref, 2 append. DOA Contract DACA 88-878-0-008.

Descriptors: *Environmental effects, *Ecological effects, *Water pollution effects, *Aquatic environment, *Computer models, Model studies, Environmental impacts, Monitoring, Ecosystems, Mitigation.

The techniques generally applicable to environmental impact analysis fell short of effective predictive capacity because of incomplete data bases and the lack of procedures for systematic data analysis to maximize data utility. To overcome these difficulties, the Construction Engineering Research Laboratory of the Department of the Army has developed a computer-based environmental impact analysis system. As part of this continuing activity, the Environmental Impact Computer Systems (EICS) has been used as a basis for development of a detailed subprogram for predicting impacts on aquatic ecosystems. The EICS system is based on the development of methodology for determination of rational threshold values (RTV). RTV includes indexes of both structural and functional community conditions that are integrated into a decision algorithm. Data for community parameters are obtained from readily available resources (STORET, National Pollution Discharge Elimination System (NPDES) permit reporting, and other state and federal water quality monitoring efforts), system subprograms that provide population predictions based on state-of-the-art population models, and actual field data. The protocols described include interactive, real-time manipulation of data based on site-specific information. The application of these protocols provides a new dimension in impact analysis methodology. Ecosystem-specific threshold levels can be set, and impacts caused by alternatives can be evaluated

efficiently and economically. This paper summarizes aquatic ecosystem RTV analysis procedures, discusses feasibility of application, and provides a sound quantitative approach to priority ordering of community parameters for aquatic ecosystem impact analysis. (See also W87-09311) (Author's abstract)
W87-09313

APPLICATION OF LABORATORY SCALE MODEL STREAMS TOWARD ASSESSING EFFLUENT IMPACTS IN FRESHWATER LOTIC ENVIRONMENTS,
Fireman's Fund Insurance Co., San Francisco, CA.
P. P. Russell, A. J. Horne, and J. F. Thomas.
IN: Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms, A Symposium Sponsored by ASTM Committee D-19, Ft. Lauderdale, FL, 29-30 January 1979. ASTM STP 730, 1981. p 32-48, 6 fig, 3 tab, 9 ref.

Descriptors: *Model studies, *Water pollution effects, *Water quality, *Lotic environment, *Effluents, Streams, chemical analysis, Temperature, Flow rate, Chemical analysis, Biomass, Aquatic environment, Growth.

Laboratory scale model streams were developed to assess the effects of oil-shale-related effluents on aufwuchs. The model stream design allowed variation of water temperature, chemical composition, flow rate, and illumination intensity and periodicity. Chemical constancy of the stream water was provided by continuously metering new water to the streams with doses of test effluents. Omega-9 water, the experiment retort water used, was studied at dilutions between 0.013 and 2.12% for 9 days. Day 3 samples generally showed stimulated growth at all dilutions. Measurements on Days 6 and 9 however, had lowered levels of growth at 1% or more Omega-9 water concentration. The more dilute effluent loads stimulated growth throughout the test period. The most marked effect of Omega-9 water was to lower the proportional contribution of diatoms to the aufwuchs biomass. Measurements of control model streams suggest a species composition heterogeneity of 10-15% with a total unloaded stream spatial/temporal variability of no greater than about 25%. The biomass measurements were very reproducible, but chlorophyll a and respiration rate assays were hampered by excessive analytic error. Field confirmation of these tentative results is strongly recommended. (See also W87-09311) (Author's abstract)
W87-09314

ECOLOGICAL FACTORS IN THE SELECTION OF REPRESENTATIVE SPECIES FOR THERMAL EFFLUENT DEMONSTRATIONS,
WAPORA, Inc., Chevy Chase, MD.
R. B. Bogardus.
IN: Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms, A Symposium Sponsored by ASTM Committee D-19, Ft. Lauderdale, FL, 29-30 January 1979. ASTM STP 730, 1981. p 49-67, 5 tab, 9 ref.

Descriptors: *Thermal pollution, *Water pollution effects, *Water quality control, *Lake Superior, *Michigan, *Block Island, *Rhode Island, *Wabash River, *Indiana, Effluents, Ecosystems, Aquatic environment, Fish, Macroinvertebrates, Aquatic plants, Regulations, Standards, Monitoring, Case studies.

A number of various federal and state guideline documents that have been issued for use in demonstrations under Section 316(a) of the Federal Water Pollution Control Act contain criteria to be applied in selecting organisms (such as fish, plants and macroinvertebrates) that are representative of the aquatic community at the proposed power plant site. This paper reviews three Section 316(a) case histories (Block Island Sound, Rhode Island; Wabash River, Indiana; and Lake Superior, Michigan) in which these selection criteria are applied and evaluates the usefulness and practicality of the methodology. The conclusion is reached that the basic approach of using representative species is practical but that the reliability and accuracy of the selection process is only as good as the available data on the seasonal distribution and life histories of the aquatic community in the receiving waters. A baseline field monitoring program designed to gather adequate data for the Section 316(a) representative species selection and evaluation process is proposed. (See W87-09311) (Author's abstract)
W87-09315

POWER-PLANT-RELATED ESTUARINE ZOOPLANKTON STUDIES,
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
L. E. Sage, and M. M. Olson.
IN: Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms, A Symposium Sponsored by ASTM Committee D-19, Ft. Lauderdale, FL, 29-30 January 1979. ASTM STP 730, 1981. p 68-88, 14 fig, 1 tab, 16 ref.

Descriptors: *Estuaries, *Water pollution effects, *Zooplankton, *Powerplants, *Chesapeake Bay, Thermal pollution, Case studies, Statistical methods, Design standards, Quantitative analysis, Sampling, Field tests, Aquatic environment.

Increased emphasis is being placed on formulating a particular study design that will generate the greatest amount of relevant information for a particular problem. This is a case history of a study design as it evolved from one level of information to another, yielding both quantitative and biologically meaningful information. In-plant studies examining the effects of entrainment on zooplankton and field studies examining zooplankton abundance, composition, and distribution in the Chesapeake Bay in the vicinity of Calvert Cliffs Nuclear Power Plant (Baltimore Gas and Electric Co.) have been conducted from 1974 to the present. The evolution of these studies, with particular emphasis on design and statistical treatment, is discussed. Entrainment study designs evolved from discrete sampling episodes at 4-hr intervals over 24-hr to a time-series sampling design in which sampling took place every 30 minutes over 24 and 48-hr periods. The near-field study design and sampling methods have included replicated net tows, using 0.5-m nets, and replicated and nonreplicated pumped samples, using a high-speed centrifugal pump. The relative collecting characteristics of sampling methods are described; study designs and applicable data analysis techniques are evaluated with respect to their ability to detect plant effects within defined limits of personnel and budgetary constraints. (See also W87-09311) (Author's abstract)
W87-09316

METHOD FOR EVALUATING THE IMPACT OF RADIOACTIVITY ON PHYTOPLANKTON,
Weston (Roy F.), Inc., West Chester, PA.
S. M. Gertz, and I. H. Suffet.
IN: Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms, A Symposium Sponsored by ASTM Committee D-19, Ft. Lauderdale, FL, 29-30 January 1979. ASTM STP 730, 1981. p 89-100, 2 fig, 2 tab, 23 ref.

Descriptors: *Radioactivity, *Water pollution effects, *Phytoplankton, *Testing procedures, Aquatic environment, Stress, Effluents, Algae, Chlamydomonas Model studies, Bioassay, Cesium.

Concentration factors are often used to assess the impact that radionuclides may have on aquatic organisms. The use of literature values or even measured concentration factors may not be appropriate for a given situation, since these factors are dependent on many environmental parameters. However, if the environmental stresses that affect a concentration factor are known and quantified, a better and potentially more efficient estimate of impact assessment can be made. The authors report here the use and results of a laboratory technique that could be used to evaluate the environmental impact of radioactive effluents on phytoplankton. The target alga is Chlamydomonas reinhardii, a common green flagellate that is amenable to growth in the laboratory. The model radionuclide is cesium-137, an important constituent of the radioactive liquid effluents from nuclear power plants. The organisms are grown in a chemostat, which consists of four growth chambers. The chemostat allows algae to be maintained in their log growth phase while various environmental parameters are manipulated. It was found that the cesium-137 concentration factors are controlled by the phosphate concentration, the sodium concentration, and the algal biomass. Temperature, algal reproduction rate, potassium concentration, and chloride concentration have no effect on the observed concentration factors. The cesium concentration factor ranges from 115 to 586 on a dry weight basis under the various environmental conditions studied. (See also W87-09311) (Author's abstract)
W87-09317

EFFECTS OF COPPER ON THE PERIPHYTON OF A SMALL CALCAREOUS STREAM,
Environmental Monitoring and Support Lab.-Cincinnati, OH. Biological Methods Branch.
C. I. Weber, and B. H. McFarland.
IN: Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms, A Symposium Sponsored by ASTM Committee D-19, Ft. Lauderdale, FL, 29-30 January 1979. ASTM STP 730, 1981. p 101-131, 8 fig, 10 tab, 24 ref.

Descriptors: *Water pollution effects, *Copper, *Periphyton, *Streams, Aquatic environment, Algae, Diatoms, Bioassay, Desmids, Heavy metals.

The effect of the continuous addition of copper to a small calcareous stream at a concentration of approximately 120 micrograms/L was studied for a year. Of the parameters evaluated in this study, the species composition of the periphyton was found to be the most sensitive and informative measure of the effects of copper. Two of the dominant species of algae in the stream were eliminated from the periphyton: the diatom Cocconeis placentula var. euglypta, and the filamentous green alga, Cladophera glomerata. Cocconeis placentula, which commonly contributed 85 to 98% of the summer diatoms in the treated reach of the stream prior to the addition of copper, was replaced by three species of diatoms, Nitzschia palea, Navicula nigrii, and N. seminulum var. hustedtii. Other species of algae that were more abundant in the copper treated reach than in the control reach of the stream were the filamentous blue-green alga, Schizothrix calcicola, and the desmids, Cosmarium granatum and C. subprotumidum. (See also W87-09311) (Author's abstract)
W87-09318

ASSESSMENT OF EFFLUENT IMPACTS THROUGH EVALUATION OF PERIPHYTON DIATOM COMMUNITY STRUCTURE,
Ecological Analysts, Inc., Northbrook, IL.
R. L. Weitzel, and J. M. Bates.
IN: Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms, A Symposium Sponsored by ASTM Committee D-19, Ft. Lauderdale, FL, 29-30 January 1979. ASTM STP 730, 1981. p 142-165, 7 fig, 6 tab, 39 ref.

Descriptors: *Water pollution effects, *Periphyton, *Diatoms, *Ecosystems, *Muskingum River, *Ohio, Copper, Industrial wastes, Population density, Species diversity, Heavy metals, Metals, Bioassay, Monitoring.

Evaluation of changes in periphyton diatom community structure proved to be a useful means of assessing the impact of an electroplating waste discharge on the biota of the Muskingum River in Ohio. The copper waste discharge decreased species richness and species diversity (as indicated by the Shannon-Weaver and Brillouin indexes) of the diatom community collected from artificial substrates. Corresponding evenness and redundancy components also indicated stressed conditions. Short-count intervals of detailed readings were compared to determine the ability and sensitivity of these shorter efforts of enumeration to respond to community changes. Counts of 500 diatom cells, while accurately responding to gross perturbations when applied in the form of biotic indexes, were

somewhat inconsistent and apparently insensitive to minor shifts in diatom community structure. Counts of 1000 diatom cells more closely paralleled the trends developed by the 5000-cell long counts. Extension of the diatom counts beyond 2000 cells yielded less species information for the man-hours required, and it was at this level that the species curve began to approach an asymptote. (See also W87-09311) (Author's abstract)
W87-09320

EFFECTS OF EXPOSURE TIME, SEASON, SUBSTRATE TYPE, AND PLANKTONIC POPULATIONS ON THE TAXONOMIC COMPOSITION OF ALGAL PERIPHYTON ON ARTIFICIAL SUBSTRATES IN THE OHIO AND LITTLE MIAMI RIVERS, OHIO,
Environmental Monitoring and Support Lab.-Cincinnati, OH. Biological Methods Branch.
C. I. Weber, and B. H. McFarland.
IN: Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms, A Symposium Sponsored by ASTM Committee D-19, Ft. Lauderdale, FL, 29-30 January 1979. ASTM STP 730, 1981. p 166-219, 5 fig, 11 tab, 24 ref.

Descriptors: *Water pollution effects, *Plankton, *Algae, *Periphyton, *Ohio River, *Little Miami River, Ohio, Seasonal variation, Population density, Species diversity, Aquatic environment, Biomass.

Standard glass microscope slides were exposed at the surfaces of the Ohio and Little Miami Rivers at Cincinnati, Ohio, for 1,2,4, and 8-week periods in June through November 1966. The maximum cell densities were attained in samples from the Little Miami River after an exposure of 1 or 2 weeks, except in November. In the Ohio River, the maximum counts were observed after exposures of 4 weeks in June and July, and 1 week in August and September. In October and November, the cell density continued to increase with increasing periods of exposure. Distinct successional patterns in the composition of the periphyton populations were not found. The changes in the composition of the periphyton with increased substrate exposure time resulted principally from seasonal changes in environmental conditions and phytoplankton populations. The maximum algal cell density, 29 000/sq mm, was observed in a 1-week sample collected in the Ohio River. The periphyton populations in both rivers were generally dominated by diatoms, which averaged 68% of the cell count. The most important genera were Achnanthes, Cyclotella, Gomphonema, Melosira, Navicula, Nitzschia, Stephanodiscus, and Synedra. Other important groups were the green flagellates and filamentous blue-green, coccoid green, and filamentous green algae. The biomasses on five sets of glass and Plexiglas slides exposed for 2 weeks in the Little Miami River during the period of August through November did not differ significantly. (See also W87-09311) (Author's abstract)
W87-09321

IMPACT OF TRINITROTOLUENE WASTEWATERS ON AQUATIC BIOTA IN LAKE CHICKAMAUGA, TENNESSEE,
Water and Air Research, Inc., Gainesville, FL.
H. D. Putnam, J. H. Sullivan, B. C. Pruitt, J. C. Nichols, and M. A. Keirn.
IN: Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms, A Symposium Sponsored by ASTM Committee D-19, Ft. Lauderdale, FL, 29-30 January 1979. ASTM STP 730, 1981. p 220-242, 10 fig, 6 tab, 17 ref. DOA Contract DAMD-17-75-C-5049.

Descriptors: *Trinitrotoluene, *Water pollution effects, *Aquatic environment, *Tennessee, *Lake Chickamauga, Lakes, Industrial wastes, Periphyton, Macroinvertebrates, Ecosystems.

Field surveys were conducted in Lake Chickamauga, Tenn., to determine the effects from wastewater discharge from the Volunteer Army Ammunition Plan. Trinitrotoluene (TNT) is the principal munitions component manufactured at this facility, and process wastes contain a complex mixture of compounds associated with the production of this explosive. Effects from the waste stream via selected components were established in periphyton and the macroinvertebrate communities, utilizing the Pinkham-Pearson Biotic Similarity Analysis. Less success was achieved in assessing impact by employing the Shannon-Weaver diversity theory. The utility of standard artificial substrates in periphyton studies was realized by comparing effects between community structures on natural substrates and glass slides. The results of the investigation show that effects on fixed biological communities from wastewater components of TNT manufacture can be detected at concentrations in the microgram per liter range. (See also W87-09311) (Author's abstract)
W87-09322

ESTABLISHMENT OF BIOTIC COMMUNITIES WITHIN A NEWLY CONSTRUCTED ASH SETTLING BASIN AND ITS DRAINAGE SYSTEM,
Texas Univ. Health Science Center at Houston. School of Public Health.
For primary bibliographic entry see Field 5E.
W87-09323

ASSESSMENT AND PREDICTION OF IMPACTS OF EFFLUENTS ON COMMUNITIES OF BENTHIC STREAM MACROINVERTEBRATES,
Michigan Univ. -Dearborn. Dept. of Biology.
W. P. Kovalak.
IN: Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms, A Symposium Sponsored by ASTM Committee D-19, Ft. Lauderdale, FL, 29-30 January 1979. ASTM STP 730, 1981. p 255-263, 1 fig, 23 ref.

Descriptors: *Water pollution effects, *Effluents, *Benthic environment, *Macroinvertebrates, Heavy metals, Statistical analysis, Model studies, Species diversity, Ecosystems.

Diversity indices, particularly those based on information theory, have been widely promoted as the best method for assessing the impact on effluents on macroinvertebrate communities. Despite their superiority, neither the Shannon-Weaver index (SWI) nor the Brillouin index (BI) is universally applicable. The SWI is preferred where effluents are selective (for example, organics) and BI preferred where effluents are nonselective (for example, heavy metals). Despite their simplicity, it should be remembered that diversity indexes supplement, not replace, community analyses based on species richness and population densities. Covariance analyses and more tightly defined stratified sampling programs are discussed as ways of improving the accuracy of density estimates. Impact prediction depends on models predicting changes in species richness and population densities. A mechanistic model predicting changes in species richness as a function of oxygen supply and demand is offered as a step in this direction. Despite its accuracy in undisturbed streams, the applicability of the model to organic and thermal pollution awaits testing. Implications of the model for impact prediction are discussed. (See also W87-09311) (Author's abstract)
W87-09324

ANNUAL MACROINVERTEBRATE SAMPLING - A LOW-COST TOOL FOR ECOLOGICAL ASSESSMENT OF EFFLUENT IMPACT,
Institute of Paper Chemistry, Appleton, WI.
M. G. Tesmer, and D. R. Wefring.
IN: Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms, A Symposium Sponsored by ASTM Committee D-19, Ft. Lauderdale, FL, 29-30 January 1979. ASTM STP 730, 1981. p 264-279, 10 fig, 3 tab, 13 ref.

Descriptors: *Macroinvertebrates, *Water quality control, *Water pollution effects, *Cost analysis, *Alabama, Environmental effects, Industrial wastes, Monitoring, Aquatic environment, Ecosystems.

Annual macroinvertebrate sampling is viewed as a low-cost tool for effluent impact assessment. The specific objectives for such studies are discussed, and the necessary restrictions required to provide meaningful results are presented. An example study is provided for demonstrating the data analysis and interpretation. The effluent discharge from the Champion International Corp. pulp and paper mill into the Tennessee River at Courtland, Ala., was monitored annually between 1970 and 1978. The study revealed that annual sampling effectively identified the causes of major fluctuations in the macroinvertebrate community structure. The effluent discharge studied was found to have a negligible effect upon the macroinvertebrate community, while the major fluctuations were attributed to natural variations in physical and hydrological conditions. The net impact of the effluent discharge upon the receiving stream was considered to be minimal over the entire study period. (See also W87-09311) (Author's abstract)
W87-09325

USE OF ASIATIC CLAM LARVAE IN AQUATIC HAZARD EVALUATIONS,
EG and G Bionomics, Wareham, MA.
R. B. Foster.
IN: Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms, A Symposium Sponsored by ASTM Committee D-19, Ft. Lauderdale, FL, 29-30 January 1979. ASTM STP 730, 1981. p 280-288, 4 fig, 1 tab, 13 ref.

Descriptors: *Clams, *Larvae, *Water pollution effects, *Hazard assessment, *Mollusks, *Toxicity, Ecosystems, Environmental effects, Water quality, Lethal limits.

Investigative efforts to predict the potential impact of single chemical species or mixed effluents on natural waterways emphasize laboratory studies of sensitive nonindigenous aquatic organisms reared under controlled laboratory conditions. Integrated aquatic hazard evaluations appropriately require species representative of a number of trophic levels, algae, invertebrates, and fish, and of different ecological niches, benthic versus pelagic, sessile versus mobile. The oyster embryo toxicity test is often applied in hazard evaluations and is a useful measure of water quality in marine and estuarine environments. Parallel methods have been developed in which freshwater Asiatic clam larvae are used to measure the relative toxicity of industrial chemicals. Two applications, the benthic acute lethality test and the larval transformation toxicity test, are presented. The results compared with other representative aquatic species of fish and invertebrates show that these applications are appropriately sensitive to industrial chemicals. Based on the simplicity and utility of these methods, the author recommends that these and other Asiatic clam monitoring techniques be adopted as tools for assessing the impact of effluents on freshwater aquatic environments. (See also W87-09311) (Author's abstract)
W87-09326

PHYSICAL AND CHEMICAL BEHAVIOR AND ENVIRONMENTAL ACCEPTABILITY OF STABILIZED SCRUBBER SLUDGE AND FLY ASH IN SEAWATER,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 5B.
W87-09327

ROLE OF ELECTROFISHING IN ASSESSING ENVIRONMENTAL QUALITY OF THE WABASH RIVER,
DePauw Univ., Greencastle, IN. Dept. of Zoology.
For primary bibliographic entry see Field 5A.
W87-09328

I ROLEUM SPILLS IN THE MARINE ENVI- MENT: THE CHEMISTRY AND FORMA- WATER-IN-OIL EMULSIONS AND TA.

Science Applications International Corp, La Jolla CA. Div. of Applied Environmental Sciences.
For primary bibliographic entry see Field 5B.
W87-09339

WASTEWATER-INDUCED SOIL CLOGGING DEVELOPMENT,
RSE Group, Ayres Association, Madison, WI 53704.
R. L. Siegrist, and W. C. Boyle.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 3, p 550-566, June 1987. 8 fig, 3 tab, 25 ref.

Descriptors: *Underground waste disposal, *Water pollution effects, *Wastewater disposal, *Model studies, *Waste disposal, *Soil clogging, *Infiltration, *Septic tanks, Clay, Loam, Design standards, Loading rate.

The development of wastewater-induced soil clogging in subsurface wastewater infiltration systems is investigated in the field over a 70-mo period. Domestic septic tank effluent (DSTE), graywater septic tank effluent (GSTE), and tapwater (TW) are intermittently applied at 1.3, 2.6, and 5.2 cm/day to replicate 0.9-m diameter pilot-scale wastewater infiltration systems installed in situ in a structured silty clay loam subsoil. Soil clogging development is negligible under all TW loadings and under GSTE loadings at 1.3 and 2.6 cm/day. Under GSTE loadings at 5.2 cm/day and under all DSTE loadings, severe soil clogging development leads to continuous ponding of the soil infiltrative surfaces. A logistic model fit to the experimental data confirms that soil clogging development is highly correlated with the cumulative mass density loadings of total biochemical oxygen demand and suspended solids (R squared = 0.95). Wastewater composition as well as hydraulic loading rate need to be considered in system design and management. (Author's abstract)
W87-09373

EFFECTS OF INTERMITTENT EXPOSURE TO SUSPENDED SOLIDS AND TURBULENCE ON THREE SPECIES OF FRESHWATER MUSSELS,
Dept. of Biology, North Carolina Agricultural and Technical State Univ., Greensboro, NC 27411, USA.
For primary bibliographic entry see Field 6G.
W87-09381

INDUCTION OF SIDEROPHORE ACTIVITY IN ANABAENA SPP. AND ITS MODERATION OF COPPER TOXICITY,
Dept. of Chemistry, Portland State Univ., Portland, OR 97207.
For primary bibliographic entry see Field 5G.
W87-09386

MULTIYEAR STUDY OF SLUDGE APPLICATION TO FARMLAND: PREVALENCE OF BACTERIAL ENTERIC PATHOGENS AND ANTIBODY STATUS OF FARM FAMILIES,
Dept. of Medical Microbiology, The Ohio State Univ., Columbus, OH 43210.
A. C. Ottolenghi, and V. V. Hamparian.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 5, p 1118-1124, May 1987. 1 fig, 11 tab, 21 ref. EPA Cooperative agreement CS805189.

Descriptors: *Land disposal, *Sludge disposal, *Water pollution effects, *Salmonellae, Isolation, Bacteria, Waste disposal, Ohio, Pathogens.

Salmonellae were isolated from sewage sludge from four treatment plants in different geographic areas of Ohio. Over 3 years, salmonellae were found 50 times in 311 sludge samples. Most isolations were made after enrichment in Selenite broth (BBL Microbiology Systems, Cockeysville, Md.). The largest proportion of isolations came from the plant serving the population of Columbus, a large metropolitan area. A significantly greater number of isolations from this plant were made during the first quarter of the year. Twenty-one different serotypes were isolated, along with five untypable strains. The most frequently isolated serotype was Salmonella infantis. Five of the strains were multiply resistant to antibiotics. The prevalence of antibodies to salmonellae in members of the families residing on the farms in the study is also described. It was found that antibodies to group C salmonellae predominated. (Author's abstract)
W87-09394

ABSENCE OF MUTAGENIC AND ANTIMUTAGENIC ACTIVITIES OF FLUORIDE IN AMES SALMONELLA ASSAYS,
Indiana Univ. School of Dentistry, Oral Health Research Inst., 415 North Lansing Street, Indianapolis, IN 46202 (U.S.A.).
Y. Li, A. J. Dunipace, and G. K. Stookey.
Mutation Research MUREAV, Vol. 190, No. 4, p 229-236, April 1987. 5 fig, 4 tab, 15 ref.

Descriptors: *Ames test, *Bioassay, *Water pollution effects, *Fluorides, *Mutagenic activity, *Mutagens, Sodium fluoride, Toxicity.

The mutagenicity of fluoride (as sodium fluoride, NaF) was investigated with Ames Salmonella/microsome assays in strains of TA97a, TA98, TA100, TA102, and TA1535. The concentrations of NaF tested ranged from 0.44 to 4421 microgram(ug)/plate (0.1 to 1000 ppm F), both with and without microsome activation. In addition, the suggested antimutagenic effect of fluoride was evaluated with known mutagens at various concentrations of NaF (0.44-442.2 ug/plate, 0.1-100 ppm F). The data showed that NaF, in amounts from 0.44 to 442.2 ug/plate (0.1-100 ppm F), failed to significantly increase the number of the revertants over the number observed in the solvent (distilled deionized water) controls. Increases of NaF to, and beyond, 1100 ug/plate (250 ppm F) resulted in a toxic effect and a reduction of the revertants to various degrees among the strains. NaF in the presence of known mutagens did not significantly decrease the number of the revertants. The results of this study indicate that NaF does not have mutagenic or antimutagenic effects in the strains tested with Ames Salmonella assays. (Author's abstract)
W87-09405

EFFECTS OF SIMULATED ACIDIC MIST ON GERMINATION OF ALTERNARIA SOLANI AND PHYTOPHTHORA INFESTANS IN VITRO AND THEIR INFECTION EFFICIENCY AND SPORULATION ON POTATO,
Boyce Thompson Inst. for Plant Research, Ithaca, NY.
A. H. C. van Bruggen, J. F. Osmeloski, and J. S. Jacobson.
Phytopathology PHYTAJ, Vol. 77, No. 4, p 564-570, April 1987. 4 fig, 6 tab, 31 ref.

Descriptors: *Acid rain, *Simulated rainfall, *Water pollution effects, *Acid rain effects, *Germination, *Alternaria, *Phytophthora, *Potatoes, *Plant diseases, Infection, Sporulation, Acidity.

Effects of acidity of simulated mist on germination of Alternaria solani and Phytophthora infestans in vitro and their infection efficiency and sporulation on potato were studied in the laboratory and greenhouse. Acidic mist solutions (pH 2.8, 3.4, 4.0, and 4.6) contained sulfuric and nitric acids in a 2:1 mass ratio (2.6:1 ratio on an H(+) equivalent basis) and background ions similar to those in ambient rain. In vitro germination of conidia of A. solani and sporangia of P. infestans decreased curvilinearly with increasing acidity, with maximum germination at pH 4.0 and 3.4, respectively, of the original solution, corresponding to pH 6.0 and 5.2 of the spore suspensions. Rooted potato cuttings of the cultivars Norchip, Monona, and Katahdin were exposed to acidic mist (pH 2.8, 3.4, 4.0, or 4.6) for 24 hr before and after inoculation with spore suspensions of either pathogen. After 48-72 hr in a greenhouse, the plants were exposed again to simulated mist at the same acidity levels to induce sporulation. When simulated mist was applied at the same acidity before and after inoculation, infection efficiency, lesion area, and sporulation of both pathogens decreased linearly or curvilinearly with increasing acidity of simulated mist. In the case of curvilinear relationships, maxima were obtained at pH 4.0. Exposure of potato leaves to simulated mist at pH 2.8 before inoculation resulted in higher infection levels than exposure to mist at pH 4.0, both before and after inoculation. However, exposure to mist at pH 2.8 after inoculation drastically reduced infection levels compared with pH 4.0, regardless of preinoculation treatment. The postinoculation acidity effect was more important than the preinoculation acidity effect. The acidity of droplets of simulated acidic mist solution on potato leaf surfaces, after termination of exposure of the leaves to simulated acidic mist, decreased rapidly to final pH levels of 6.3-7.7, when initial pH levels of simulated mist and droplets were 3.4 or 4.0. At pH 2.8 the neutralizing capacity of the leaves was reduced after exposure to simulated acidic mist and the pH rose only to 4.0-5.0, depending on the duration of exposure. (Author's abstract)
W87-09414

YIELD REDUCTIONS IN WINTER BARLEY GROWN ON A RANGE OF SOILS AND EXPOSED TO SIMULATED ACID RAIN,
Inst. of Terrestrial Ecology, Bangor Research Station, Penrhos Road, Bangor Gwynedd LL57 2LQ, North Wales, UK.
T. W. Ashenden, and S. Bell.
Plant and Soil PLSOA2, Vol. 98, No. 3, p 433-437, 1987. 1 fig, 2 tab, 16 ref.

Descriptors: *Barley, *Water pollution effects, *Acid rain effects, *Acid rain, *Simulated rainfall, Food crops, Crop yield, Rainfall, Plants, Soil types, Field tests.

Seedlings of winter barley were grown in a range of British soils and subjected to simulated acid rainfall treatments of 3 cm per week at pH's of 2.5, 3.5, 4.5 and 5.6. After 21 weeks, it was found that there were highly significant effects overall of the rainwater treatments on the dry weights of leaves, stems, roots, ears and total plant. There was a trend for lower yields with increasing acidities of rainwater treatments. It was calculated, as an averaged effect over the range of soil types, that yield reductions of 10-30% can occur in response to the critical pH range of rainfall of 3.5-4.5. It was concluded that there was an urgent need for further studies on the field trial basis. (Author's abstract)
W87-09416

EFFECTS OF POLLUTION BY ORGANIC SUGAR MILL EFFLUENT ON THE MACROINVERTEBRATES OF A STREAM IN TROPICAL QUEENSLAND, AUSTRALIA,
Dept. of Zoology, James Cook Univ. of North Queensland, Queensland 4811, Australia.
R. G. Pearson, and L. K. Penridge.
Journal of Environmental Management JEVMAW, Vol. 24, No. 3, p 205-215, April 1987. 4 fig, 3 tab, 13 ref.

Descriptors: *Water pollution effects, *Sugar mills, *Effluents, *Macroinvertebrates, *Queensland, Australia, Tropical regions, Dissolved oxygen, Industrial wastewater.

The discharge of organic effluent from a sugar mill into a stream in tropical north Queensland was shown to have similar effects on the macro-invertebrate fauna to those found in temperate streams. Increased pollution led to decreased diversity, and, in heavily polluted situations, the fauna was dominated by Oligochaeta and one species of Chironomidae, or in the most severe conditions by that chironomid alone. The effects of pollution became apparent as the dissolved oxygen concentration fell below 6.5 mg/L, and were most severe below 3.5 mg/L. These results were obtained using simple techniques that could be used readily by non-specialist mill staff to monitor stream quality. (Author's abstract)
W87-09421

ECOHYDRODYNAMICS AND SIMULATION: SOME RELEVANT PROBLEMS OF SCALE-UP AND -DOWN,
Osaka Univ., Suita (Japan).

S. Aiba.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 63-72, 3 fig, 1 tab, 12 ref.

Descriptors: *Water pollution effects, *Scale effects, *Design criteria, Eutrophication, Algae, Rivers, Lakes, Dissolved oxygen, Microcystis aeruginosa.

Ecohydrodynamics is defined as an applied branch of science that pertains to a relationship between an ecosystem and its hydraulic environment. This paper gives some examples of scale-up and scale-down of simulation of a dissolved oxygen profile in a shallow, polluted river (Tama-gawa near Tokyo) and an algal bloom in a eutrophic lake. Some principles in aerobic fermentation are applied. Scale-up and scale-down in ecohydrodynamics is divided into two categories: physical problems and problems related to the microorganism. Estimation of parameters in system equations for hydrodynamic and ecological characteristics requires small-scale laboratory works. Comparison between calculation for the simulation and observation would provide a means to judge whether assessment of parameters in laboratory experiments for algal as well as ecological unit processes is acceptable in the light of observation of the large-scale phenomena. (Cassar-PTT) (See also W87-09431)
W87-09436

1984 ANNUAL REPORT TO THE PRESIDENT AND CONGRESS: NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM.
Interagency Task Force on Acid Precipitation, Washington, DC.
For primary bibliographic entry see Field 5B.
W87-09479

TOXICITY OF BALLAST-WATER TREATMENT EFFLUENT TO MARINE ORGANISMS AT PORT VALDEZ, ALASKA,
National Marine Fisheries Service, Auke Bay, AK. Auke Bay Lab.
S. D. Rice, S. Kor, C. C. Brodersen, S. A. Lindsay, and S. A. Andrews.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 55-61, 4 fig, 3 tab, 13 ref.

Descriptors: *Effluents, *Toxicity, *Hydrocarbons, *Oily water, *Alaska, Environmental effects, Wastewater treatment, Marine animals, Port Valdez.

Approximately 12 million gallons of oily ballast water is taken ashore and treated daily at the Alyeska treatment plant, where tankers take on crude oil at the terminus of the Trans Alaska pipeline near Valdez, Alaska. Most oil is removed, but some light aromatic hydrocarbons (1 to 16 parts per million) remain in the large volume of discharged effluent. Between May and July, the concentration of aromatic hydrocarbons in the treated effluent (measured by gas chromatography) generally declined as the seasonal temperatures increased. The toxicity of the effluent was measured on site at Valdez. For the larvae of crustaceans and of fish the median lethal concentration LC50 was between 10 and 20% of treated effluent in 96-hour static tests. For salmon fry and shrimp in repeated acute flow-through assays, the (LC50) was quite consistent, between 20 and 40% of treated effluent. Because the concentration of aromatic hydrocarbons was much lower in the later tests but the toxicity of the effluent was not lower, toxicants other than aromatic hydrocarbons must contribute significantly to the toxicity of the effluent from the ballast-water treatment plant. (Author's abstract)
W87-09514

TOXICITY OF CHEMICALLY DISPERSED OIL TO SHRIMP EXPOSED TO CONSTANT AND DECREASING CONCENTRATIONS IN A FLOWING SYSTEM,
Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.
J. W. Anderson, S. L. Kiesser, R. M. Bean, R. G. Riley, and B. L. Thomas.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 69-75, 2 fig, 4 tab, 22 ref.

Descriptors: *Oil spills, *Oil pollution, *Toxicity, *Pandalus danae, *Dispersants, Chemical treatment, Shrimp, Oily water, Oil.

The shrimp Pandalus danae was exposed, in a flowing system, to a water extract of Prudhoe Bay crude oil and to chemically dispersed dilutions of this oil. Mortality produced over a period of 10 hr to 9 days was followed to the point of 50% survival in each tank. The product of time to 50% mortality (in days) and the measured concentration (in parts per million (ppm)) in each tank was used to describe the toxicity of the solutions. This toxicity index (ppm-days) was 4.5 times higher in the winter and fall than in spring and summer tests with the same oil extract. In the warmer months, when shrimp were more sensitive, oil dispersed with chemicals was about half as toxic as the seawater extract of the oil. Differences in the concentrations of specific petroleum hydrocarbons in the seawater extract and the chemically dispersed oil aid in explaining the toxicity observed. Toxic aromatics represent 98% of the extract but only 67% of the dispersed oil since the latter is enriched with droplets of oil containing 33% saturated and other insoluble components. Linear dilution of dispersed oil to zero in 26 hr resulted in toxicity indices quite similar to those produced in constant exposure. (Author's abstract)
W87-09516

EFFECTS OF DIMETHYLNAPHTHALENE AND FLUCTUATING TEMPERATURES ON ESTUARINE SHRIMP,
Virginia Inst. of Marine Science, Gloucester Point.
T. M. Dillion.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 79-85, 7 fig, 2 tab, 47 ref.

Descriptors: *Oil spills, *Oil pollution, *Toxicity, *Environmental effects, *Dimethylnaphthalenes, Biodegradation, Hydrocarbons, Palaemonetes pugio, Shrimp, Fish food, Fluctuating temperatures.

The biological effects of a naturally occurring water temperature and water-quality perturbation were compared with those of a perturbation that may be induced by human activities in the coastal zone. The estuarine shrimp Palaemonetes pugio was exposed for 32 days to fluctuating (18 - 22 C) temperatures (FT), to food contaminated with 2,6-dimethylnaphalene (DMN) at a concentration to wet weight food of 0.24 microgram per gram, or to both. Relative survival rates were evaluated in a matrix of environmental challenge tests. Resistance to hypoxia plus reduced salinity was significantly reduced by exposure to FT and DMN-contaminated food. The influence of FT was much stronger and obscured the effects of DMN-contaminated food when shrimp were exposed to both perturbations at the same time. The persistent, residual effects of FT and DMN-contaminated food in reducing resistance of Palemonetes pugio to hypoxia was evaluated after a 16-day recovery period with stable temperatures and uncontaminated food. The harmful effects of FT appeared to be reduced by the period of stable temperatures. On the other hand, shrimp that had ingested DMN-contaminated food before the clean food showed increased resistance to hypoxia. A number of sublethal measurements related to aerobic metabolism were made in order to find an index that would be useful in discriminating the effects of FT from DMN-contaminated food and to determine the affected mechanism(s) that lead to altered survival in hypoxia. No measurement examined could satisfactorily explain the observed effects of FT on resistance to hypoxia, independent of diet regime. However, shrimp exposed to both FT and DMN-contaminated food had increased respiratory rates and oxygen to nitrogen rates decreased metabolic independence from external oxygen, and low hemolymph copper concentrations. Measurements that may be useful in detecting stress resulting from DMN-contaminated food, independent of temperature regime, include nitrogen excretion rates, hemolymph copper, and the relation between oxygen consumption and external oxygen. After the shrimp had ingested contaminated food for 32 days, the concentration of DMN in their tissues was significantly greater than that in the food. Shrimp kept in FT had higher concentrations of DMN than shrimp held at stable temperatures. (Author's abstract)
W87-09517

ONSHORE IMPACTS AND CLEANUP DURING THE BURMAH AGATE OIL SPILL - NOVEMBER 1979,
Research Planning Inst., Inc., Columbia, SC.
L. C. Thebeau, and T. W. Kana.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 139-145, 6 fig, 7 ref. Contract No. 79RAC00033.

Descriptors: *Oil spills, *Cleanup operations, *Oil recovery, *Environmental effects, *Texas, Oil pollution, Burmah Agate, Galveston.

Of the 250,000 barrels (bbl) of oil spilled or consumed by fire during the Burmah Agate spill of Galveston, Texas, in November 1979, 2,100 bbl eventually reached the shore. Fortunately, because of the predominance of offshore, northerly winds in November 1979, most of the oil not consumed by fire dispersed offshore or was contained and recovered at the wreck site. Daily aerial and ground surveys at reference stations were conducted to locate impacts and monitor the persistence of oil onshore. Beach impacts directly attributable to the Burmah Agate occurred as far as 470 km from the wreck near Mansfield Pass, Texas. The first major impact occurred on November 8 and 9 when approximately 500 bbl impacted a 10-km section of San Jose Island, 250 km southwest of the wreck. Due to relative inaccessibility, and rapid recovery of the beach, no cleanup was attempted. By November 16, 1979, less than 25% of the impact remained buried or on the beachface. The heaviest onshore impact of Burmah Agate oil occurred November 19 to 21 when up to 1,500 bbl beached along the western Half of Galveston Island. Cleanup was initially by manual labor and front-end loaders; however, by November 23, the primary method of cleanup involved pooling the oil by hand labor and picking it up with vacuum trucks. This latter method considerably reduced the volume of sand removed from the beach. Cleanup and manicuring the beach were virtually complete by November 27. Other minor impacts of less than 50 bbl occurred sporadically during the spill from Bolivar Peninsula to Brown Cedar Cut. The only known marsh impact occurred on November 9, when approximately 5 bbl coated 400 meters of fringing marsh along Smith Point in Galveston Bay. (Author's abstract)
W87-09518

BIOS PROJECT - FRONTIER OIL SPILL COUNTERMEASURES RESEARCH,
Environmental Protection Service, Edmonton (Alberta).
For primary bibliographic entry see Field 5G.
W87-09523

COASTAL ECOSYSTEM STUDIES AND THEIR APPLICATION TO OIL SPILL RESPONSE,
National Coastal Ecosystems Team, Slidell, LA.
J. W. Parsons.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 311-317, 4 fig, 12 ref.

Descriptors: *Oil spills, *Environmental effects, *Ecological effects, Distribution patterns, Oil pollution, Coastal waters, Oil, California, Maine, Alaska, Hawaii.

Because of increased energy demands, the coastal areas of the United States have been subject to rather severe land-use and water-use conflicts. One of the results has been the alteration of coastal habitats that support valuable fish and wildlife resources. Because of threats of further alteration, the U.S. Fish and Wildlife Service (FWS) has

conducted several studies about coastal environments and environmental problems. Since 1975, nine coastal ecological studies have been completed; others are being negotiated. Study areas have included the coast of Maine, and central and northern California. Each of these studies provides an information base, a data analysis, and habitat maps. An ecological inventory of the Atlantic Coast has been completed and other inventories are contemplated for the Gulf of Mexico, the West coast of the United States, Alaska and Hawaii. The ecological inventories mainly are maps showing types of land use and coastal fish and wildlife resources and their habitats. Other more site-specific or species-specific studies have also been published. These various reports about coastal ecology should be useful to national, regional, and field spill response teams for understanding environmental concerns more fully, planning regional oil spill responses, making on-site decisions, and planning post-spill environmental damage. (See also W87-09507) (Author's abstract)
W87-09539

MAPPING THE DISTRIBUTION OF PROTECTED AND VALUABLE, OIL-SENSITIVE COASTAL FISH AND WILDLIFE,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
For primary bibliographic entry see Field 7A.
W87-09540

IMPACT OF OIL ON MARSH COMMUNITIES IN THE ST. LAWRENCE RIVER,
State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse.
M. M. Alexander, P. Longabucco, and D. M. Phillips.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 333-340, 3 fig, 5 tab, 28 ref.

Descriptors: *Environmental effects, *Ecological effects, *Marshes, *Coastal marshes, *Oil spills, Oil pollution, Oil, St. Lawrence River, Fuel.

A 2-yr investigation of fish and waterfowl populations was conducted on St. Lawrence River marshes that had been polluted with No. 6 industrial fuel on June 23, 1976. The heavy oil, which penetrated as much as 5 m into the dense cattail stands, was removed along with the oiled vegetation. This was a zone of intense animal activity and mortality was great during the first few weeks. Marshes having different levels of oiling were selected for study along with a control area because prior baseline data were not available. The results suggested but could not prove that there was some long-range effects of the oil on these marsh communities. An example is the possible loss of eggs and larval fish for some species. However, the effects of the oil generally were masked by the effects of natural factors, and therefore difficult to identify or quantify. Variables such as water level, time of year, water temperatures, type of oil, physical arrangement of marshes, and the cleanup process each had an important role in the overall impact. The study demonstrated that the dynamic nature of marsh populations and communities make it imperative that the ecology of sensitive areas be studied in advance so that meaningful assessments can be made on a long-term basis. It also pointed out the danger of misinterpreting changes observed as being due to oil when in reality many interrelated natural factors are having their effects on populations and communities at the same time. (See also W87-09507) (Author's abstract)
W87-09541

POLYCYCLIC AROMATIC HYDROCARBONS IN OYSTERS (CRASSOSTREA VIRGINICA) FROM GEORGIA COASTAL WATERS, ANALYZED BY HIGH-PRESSURE LIQUID CHROMATOGRAPHY,
Skidaway Inst. of Oceanography, Savannah, GA.
For primary bibliographic entry see Field 5A.
W87-09542

GEOMORPHOLOGICAL ALTERATION OF A HEAVILY OILED SALTMARSH (ILE GRANDE, FRANCE) AS A RESULT OF MASSIVE CLEANUP,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
For primary bibliographic entry see Field 5B.
W87-09543

FATE OF THE ZOE COLOCOTRONI OIL SPILL AND ITS EFFECTS ON INFAUNAL COMMUNITIES ASSOCIATED WITH MANGROVES,
Bowdoin Coll., Brunswick, ME. Marine Research Lab.
E. S. Gilfillian, D. S. Page, R. P. Gerber, S. Hansen, and J. Cooley.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 353-360, 6 fig, 4 tab, 11 ref.

Descriptors: *Oil pollution, *Oil spills, *Environmental effects, *Infaunal communities, *Puerto Rico, Mangroves, Zoe Colocotroni, Bahia Sucia, Oil.

During 1978 and 1979, sediment samples were collected in the mangrove areas on the west side of Bahia Sucia, Puerto Rico, to examine the effects of oil discharged from the tanker Zoe Colocotroni (March 18, 1973) on the infaunal community. Samples for benthic community analysis and hydrocarbon analysis were taken in representative types of mangrove habitats and compared with habitats in a reference area some distance from the spill site. Infaunal organisms larger than 0.5 mm were included in this study. Correlation of biological and chemical data indicates that for the high salinity habitats there were more infaunal organisms larger than 0.5 mm in the oiled area than in the unoiled area. Analyses of the red mangrove fringe areas showed that the distribution of infaunal organisms was not related to the distribution of oil in an obvious way. Large numbers of organisms were found in some heavily oiled areas. Even the most diverse communities seen in the impact area were not as diverse as the community seen in the unoiled reference area. We conclude that only in the red mangrove environment is there remaining damage to infaunal communities from the Zoe Colocotroni oil spill. (See also W87-09507) (Author's abstract)
W87-09544

TEN YEARS OF SALTMARSH MONITORING - THE CASE HISTORY OF A SOUTHAMPTON WATER SALTMARSH AND A CHANGING REFINERY EFFLUENT DISCHARGE,
Field Studies Council, Pembroke (Wales). Oil Pollution Research Unit.
B. Dicks, and K. Iball.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 361-374, 12 fig, 5 tab, 12 ref.

Descriptors: *Oil pollution, *Effluents, *Salt marshes, *Wastewater treatment, Environmental effects, Toxicity, Hydrocarbons, Oil, Oil refineries.

One of the largest refinery and petrochemical plants in the U.K. has been discharging its effluents into the creek system of a Spartina anglica-dominated saltmarsh in Southampton Water since 1953. This resulted in extensive damage to the marsh system up to 1971. At that time, a program of effluent quality improvement commenced that has resulted first in recolonization of small areas of damaged marsh followed by extensive recovery. Changes in the marsh vegetation have been studied first by transect surveys in 1969 and 1970 (to assess damage) and subsequently by twice-yearly vegetation mapping resurveys from 1972 to the present. This paper summarizes the data from the 10 yr survey. The recovery/recolonization has continued progressively to the present day, with improvements in effluent quality clearly related to saltmarsh recovery. However, although several annual and perennial marine species have been successful colonizers, the original dominant Spartina anglica has recolonized only poorly. In addition to vegetation mapping, several series of Spartina transplantation experiments have been carried out to precisely define areas of continued effluent impact. These have formed a nucleus for Spartina recolonization in some parts of the marsh and may well speed up the return of this species in these areas. Using these relatively simple techniques it has been possible to identify differences in toxicity between different outfalls. This has been taken into account in site effluent management policy. Research programs have recently been extended to include recolonization of the march by intertidal animals and detailed analyses of hydrocarbon contents of sediments over the marsh. Preliminary results from these programs are described. These additional techniques improve monitoring sensitivity and provide valuable information for interpreting long-term effects of retention of hydrocarbons in sediments. They are designed to monitor continued effluent improvements being undertaken by the refinery. (See also W87-09507) (Author's abstract)
W87-09545

RESTORATION OF OILED MARSHES THROUGH SEDIMENT STRIPPING AND SPARTINA PROPAGATION,
St. Mary's Coll. of Maryland, St. Mary's City.
For primary bibliographic entry see Field 5G.
W87-09546

CONTAMINATION OF GROUNDWATER BY HYDROCARBONS FROM A REFINERY - A CASE HISTORY,
O'Connor (M.J.) and Associates Ltd., Calgary (Alberta).
For primary bibliographic entry see Field 5G.
W87-09547

EFFECTS OF OIL SPILL CLEANUP TECHNIQUES ON A SALT MARSH,
Lamar Univ., Beaumont, TX. Dept. of Biology.
C. A. McCauley, and R. C. Harrel.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 401-407, 2 fig, 3 tab, 21 ref.

Descriptors: *Oil spills, *Cleanup operations, *Environmental effects, *Salt marshes, Oil pollution, Evaporation, Performance evaluation, Neches River, Port Neches, Texas.

On January 28, 1979, an oil spill occurred in the lower Neches River near Port Neches, Texas. Southerly winds carried oil into Bessie Heights Marsh affecting some of the vegetation which is primarily Spartina patens. This study was designed to assess the effects of three methods of oil spill cleanup and to determine which method was least harmful to the marsh. All methods begin with absorption and low-water-pressure washing followed by either (1) burning, (2) cutting and removing, or (3) leaving the affected vegetation alone. Grams per square meter of harvested vegetation, numbers of individuals, numbers of taxa, and diversity of macroinvertebrates were subjected to analysis of variance to test for differences within and between selected treatments. Chi square values utilizing numbers of individuals for all taxa occurring in at least 50% of the sample plots were also calculated. Statistical analysis of data indicated that burning the impacted vegetation had the most harmful effect. Leaving the vegetation alone after the bulk of the oil had been removed appeared to be the best method of cleanup of an oiled Spartina patens marsh. (See also W87-09507) (Author's abstract)
W87-09548

IMPACT OF THE ESSO BAYWAY OIL SPILL ON SALT MARSH MACRO FAUNA,
Texas A and M Univ., College Station. Dept. of Biology.
J. M. Neff, M. S. Sharp, and W. L. McCulloch.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 413-418, 1 fig, 6 tab, 22 ref.

Descriptors: *Oil spills, *Environmental effects, *Salt marshes, *Macrofauna, *Texas, Fuel, Oil pollution, Penaeus aztecus, Brown shrimp, Penaeus setiferus, Penaeid shrimp, Oil, Neches River.

On January 28,1979, approximately 6,000 barrels of light Arabian crude oil was spilled into the lower Neches River near Port Neches, Texas. Much of the oil became stranded in the adjacent brackish-freshwater marsh, which is considered to be an important nursery area for postlarval penaeid shrimp. The purpose of this investigation was to assess the long-term impact of the spill on the macrofauna of the marsh. Petroleum hydrocarbon concentrations in marsh sediments were high (up to 7,000 mg/kg dry wt) at all but one unoiled reference station. Due to unusually high rainfall, salinity in the marsh was very low until September 1979, when it rose to 6 to 12 parts per thousand. Macrocrustacean and fish populations were very similar at both oiled and reference stations in terms of species composition, number of species, and number of animals. Species diversity indices were similar at oiled and reference stations. Postlarval penaeid shrimp Penaeus setiferus did not enter the marsh until September when the salinity rose. They were equally abundant at oiled and reference stations. We conclude from this 9-month study that the spilled oil had little or no significant effect on the aquatic macrofauna, including penaeid shrimp, of the Neches River marshes. Environmental factors, salinity, and temperature, had a much greater effect on the marsh populations and obscured any effects that might be attributed to oil. (See also W87-09507) (Author's abstract)
W87-09550

IMPACTS OF A SPILL OF NO. 6 FUEL OIL ON LAKE WINONA,
Winona State Univ., MN. Dept. of Biology.
C. R. Fremling.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 419-421, 3 ref.

Descriptors: *Oil spills, *Fuel, *Environmental effects, *Minnesota, Oil pollution, Cleanup operations, Lake ice, Lakes, Lake Winona.

A spill of about 7,400 gallons of No. 6 fuel oil into Lake Winona provided an unusual opportunity to observe the behavior of a residual fuel oil in a confined freshwater environment. Oil-laden condensate from Winona State University's heating plant entered Lake Winona via a storm sewer during the winter and, because of ice cover, went undetected until April 15, 1979. Because its density was almost the same as water, the oil caused unusual problems. Surface fractions were readily removed by standard measures, but cleanup was thwarted by heavier fractions which rose continually from the lake bottom and drifted throughout the lake. Scuba divers located a pool of heavy oil in a deep area near the storm sewer outlet and most of it was pumped into an on-shore reservoir. Globules of oil continued to rise from the lake bottom during the ensuing summer season, severely curtailing recreational use of the lake. The spill resulted in the deaths of waterfowl and it apparently stressed spawning sunfish sufficiently to trigger a kill by Flexibacter Columnaris bacteria. The oil produced no taste problems in fish flesh. The cost of cleanup was almost $104,000, and a civil penalty of $3,500 was levied against the State of Minnesota. The entire episode was documented photographically. (See also W87-09507) (Author's abstract)
W87-09551

COMPREHENSIVE MODEL FOR OIL SPILL SIMULATION,
For primary bibliographic entry see Field 5B.
W87-09552

ATLANTIC EMPRESS SINKING - A LARGE SPILL WITHOUT ENVIRONMENTAL DISASTER,
Mobil Oil Corporation, New York.
S. A. Horn, and P. Neal.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 429-435, 14 fig, 1 ref.

Descriptors: *Oil spills, *Cleanup operations, *Environmental effects, Dispersants, Booms, Flocculation, Atlantic Empress, Caribbean Sea.

At 1900 hours on July 19, 1979, the 288,000-deadweight-ton (dwt) Atlantic Empress and the 207,000 dwt Aegean Captain collided in the Caribbean Sea. In the fiery aftermath of the accident, 27 crewmen lost their lives. There was a strong possibility that a total of 3.5 million barrels of crude oil would be spilled; this would have been the largest spill to that time. Nearby islands with their tourist beaches and coral reefs were threatened. And yet, no oil came ashore and no indications of any environmental damage were observed. This paper provides a chronicle of the events of the days following the collision, including (1) activation of the Clean Caribbean Cooperative equipment stockpile, (2) airlifting 13 planeloads of firefighting foam, oil transfer gear, dispersants and pollution control equipment, (3) assembling an expert response team with an operation based on Trinidad, (4) providing four single-engine aircraft dispersant-spraying capability, and (5) mounting a major firefighting effort on board the burning ship. The Atlantic Empress was the largest ship ever to sink. However, through a coordinated response effort and considerable assistance from natural forces, no harmful pollution resulted. (See also W87-09507) (Author's abstract)
W87-09553

IXTOC I OIL SPILL - THE DAMAGE ASSESSMENT PROGRAM AND ECOLOGICAL IMPACT,
E. G. Woods, and R. P. Hannah.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 439-443, 1 fig, 9 ref.

Descriptors: *Oil spills, *Performance evaluation, *Cleanup operations, *Ecological effects, Oil pollution, Oil wells, Oil, Ixtoc I, Bay of Campeche, Mexico.

On June 3, 1979, the Ixtoc I well blew out in the Bay of Campeche, Mexico. Before the well was capped on March 23, 1980, approximately 3.3 million of the estimated 140 million barrels (bbl) of spilled oil impacted the South Texas coast. This event activated U.S. response and cleanup activities that are authorized and organized under the National Contingency Plan (NCP). A formal plan to assess damage from waterborne pollutants did not exist before this spill. Therefore, an ad hoc committee with representatives from private institutions, industries, universities, and state and federal agencies with primary responsibilities or interest in resource protection was formed to develop the scientific approach and management structure for the damage assessment plan that was developed during this crisis situation. The purpose of this paper is to describe the formation of an ad hoc interagency damage assessment organization, to outline the concept and goal of the comprehensive Ixtoc I Damage Assessment Program, and to describe the implementation of the monitoring phase of this program. The paper also offers specific recommendations for future damage assessment endeavors. (See also W87-09507) (Author's abstract)
W87-09554

EFFECTS OF THE IXTOC I OIL SPILL ON TEXAS SHOREBIRD POPULATIONS,
Corpus Christi State Univ., TX.
B. R. Chapman.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 461-465, 4 fig, 2 tab, 21 ref.

Descriptors: *Oil spills, *Environmental effects, *Waterfowl, *Texas, Oil pollution, Ecological effects, Oily water, Oil slicks.

Oil from the Ixtoc I blowout on June 3, 1979, washed ashore in an area where few baseline studies, particularly on bird populations, had ever been conducted, but there was enough time before impact for limited population data to be collected. By the time the oil reached the Texas coast in August, it had been broken up into small mousse pancakes, isolated slicks, or masses of tar balls. As these oil patches washed ashore, the birds were able to adjust their distribution to avoid oiled areas. When the foreshore of the lower Texas coast became covered with oil, shorebirds were forced to occupy poor feeding habitats on the backshore and around rain pools; less than 20% of the population remained on the foreshore. Because of the shift in habitat use, few birds were severely oiled. The percentage of total birds with moderately oiled plumage never exceed 10%, but some species were more prone to oiling than others. The behavior of oiled and oil-free birds was compared by time budget methods. Oiled sanderlings and willets spent less time feeding and more time resting and engaging in comfort movements. A series of tropical storms in mid-September cleaned the beaches and reversed the long-shore currents. Shorebirds returned to foreshore areas, but not at preimpact densities. Birds continued to avoid areas near tar mats. (aggregations of asphaltic oil and shell). (See also W87-09507) (Author's abstract)
W87-09555

EFFECTS OF THE IXTOC I OIL SPILL ON THE INTERTIDAL AND SUBTIDAL INFAUNAL POPULATIONS ALONG LOWER TEXAS COAST BARRIER ISLAND BEACHES,
Research Planning Inst., Inc., Columbia, SC.
L. C. Theveau, J. W. Tunnell, Q. R. Dokken, and M. E. Kindinger.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 467-475, 5 fig, 10 tab, 18 ref.

Descriptors: *Oil spills, *Intertidal areas, *Fauna, Oil pollution, Environmental effects, Population density, Ecological effects, Oil.

Pre-spill (August 4 to 11, 1979) and post-spill (September 24 to 29, 1979) sampling of intertidal and subtidal infaunal populations along lower Texas coast sandy beaches was conducted to determine the impact of the Ixtoc I oil spill. Transects sampled between the Rio Grande and Port Arkansas produced 52 species of macroinfauna primarily dominated in abundance and diversity by polychaetes and haustoriid amphipods. Analyses revealed visible, though not significant, decreases in pooled intertidal population densities and significant reductions in pooled subtidal population densities. Numbers of species did not significantly change. Population density changes may have been caused by Ixtoc I impact, tropical depression/storm beach erosion, seasonal fluctuations, beach cleanup techniques, or a combination of these. (See also W87-09507) (Author's abstract)
W87-09556

IMPACT AND PERSISTENCE OF IXTOC I OIL ON THE SOUTH TEXAS COAST,
Research Planning Inst., Inc., Columbia, SC.
E. R. Gundlach, K. J. Finkelstein, and J. L. Sadd.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 477-485, 8 fig, 1 tab, 10 ref.

Descriptors: *Oil spills, *Environmental effects, *Mapping, Coastal waters, Oil pollution, Oily water, Oil, Texas, Gulf of Mexico.

The blowout of Ixtoc I on June 3, 1979, released at least 476,000 tons of oil into the Gulf of Mexico until the well was capped on March 24, 1980. The predicted northward drift of the oil caused the U. S. government to sponsor a pre-spill coastline mapping project (called the Environmental Sensitivity Index), which was used in developing the response strategy of the U.S. Coast Guard Strike Team and accurately predicted the reaction and persistence of Ixtoc I oil along Gulf Coast beaches when major impacts occurred during August and September 1979. In total, approximately 3,9000 tons of Ixtoc I oil washed onto exposed beaches of fine-grained sand and mixed sand and shell in south Texas. Little oil passed into the productive back-barrier lagoons. A tropical storm on September 13, 1979, removed more than 90% of the beached oil. By spring 1980, oil remained only as scattered tar mats (8% oil, 180 tons total) at the toe of the beach. The quantity of tar balls on the beach could not be differentiated from chronic accumulations. (See also W87-09507) (Author's abstract)
W87-09557

EFFECTS OF OIL SPILLS ON MANGROVE FORESTS: A COMPARISON OF FIVE OIL SPILL SITES IN THE GULF OF MEXICO AND THE CARIBBEAN SEA,
Research Planning Inst., Inc., Columbia, SC.
C. D. Getter, G. I. Scott, and J. Michel.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 535-540, 9 fig, 1 tab, 8 ref.

Descriptors: *Oil spills, *Environmental effects, *Oil pollution, *Mangrove swamps, Coastal waters, Oil, Ecological effects, Florida Keys, Tampa Bay.

Recent field studies at five oil spill sites where mangroves were effected provide a broad base of information on the response of mangrove communities to oiling. Three study sites in Florida (two in the Florida Keys, one in Tampa Bay) and two in eastern Puerto Rice were visited in 1978, 1979, and 1980. At each site, impacts on mangroves were assessed by the compartmental method, which uses statistical comparisons of ecological parameters between impacted and comparison stations and produces an array of biological and geomorphic data sets that allows spill sites to be compared. Despite many differences in the size of the spills and the spill sites, the responses of the oiled mangrove communities were similar in terms of tree mortality; leaf defoliation, deformation, and stunting; seedling deformation and mortality; lenticel expansion; adventitious growth of pneumatophores; and changes in the density and distribution of plants and animals. Each spill site differed mainly in the magnitude of the stress response. Observations of the spills showed that differences in the physical environment, such as the degree of exposure to waves and currents and geomorphic features like the terrain, greatly influence the distribution and persistence of oil within different mangrove forest types. From these studies, mangrove forest types can be ranked by their predicted sensitivity to oil. This differentiation in ranking increases the value of the Environmental Sensitivity Index, especially where it is desirable to assign priorities in a campaign to protect oil-sensitive habitats from oil spills along mangrove-dominated coastlines. (See also W87-09507) (Author's abstract)
W87-09558

EFFECT OF CRUDE OIL ON MICROBIAL PROCESSES IN MARINE SEDIMENTS,
Mississippi State Univ., Mississippi State. Dept. of Biological Sciences.
G. W. Childers, R. W. Landers, H. G. Aranha, M. S. Randolph, and A. H. Ardahl.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 731-735, 5 fig, 1 tab, 2 ref.

Descriptors: *Oil spills, *Environmental effects, *Ecological effects, *Oil pollution, *Marine sediments, Oily water, Sediments, Oil, Gulf of Mexico, Microbiological studies.

Studies were carried out to detect and quantitate 12 microbial processes occurring in sediments in the north central Gulf of Mexico, and to determine the impact of low-level concentrations of oil on these processes. Under the simulated in situ conditions employed, photosynthesis, nitrification, denitrification, nitrogen fixation, sulfate reduction, and phosphate uptake were minimal, while sulfur oxidation and catabolic carbonaceous processes (heterotrophic activity, lipolysis, proteolysis cellulolysis, and chitinolysis) were presented with varying degrees of activity. Little difference in metabolic activity was detected between oil-production platform sites and corresponding control sites, among different sediment types, or among three sampling seasons, and the presence of oil at up to 200 microliter per milliliter sediment had no significant impact on reaction rates. Pure culture studies confirmed that low-level concentrations of crude oil had essentially no effect on these processes. (See also W87-09507) (Author's abstract)
W87-09567

WATER IN MINING AND UNDERGROUND WORKS (EL AGUA EN LA MINERIA Y TRABAJOS SUBTERRANEOS), VOLUMES I AND II.
Asociacion Nacional de Ingenieros de Minas, Consejo Superior de Colegios de Ingenioeros de Minas, Granada (Spain).
For primary bibliographic entry see Field 2F.
W87-09568

INFLUENCE ON THE GROUNDWATER CONDITIONS IN A MULTILAYERED AQUIFER SYSTEM BY ALUM-SHALE MINING,
Loussavaara-Kirunavaara AB, Skovde (Sweden).
L. Baeckstroem, L. Carlsson, A. Carlstedt, and A. Heornsten.
IN: Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 17-25, 6 fig, 1 tab, 3 ref.

Descriptors: *Groundwater pollution, *Mine wastes, *Leaching, *Mathematical models, *Groundwater movement, Uranium, Aquifers, Numerical analysis, Leaching, Leachates, Groundwater recharge, Model studies, Geohydrology, Fate of pollutants, Mathematical studies, Permeability coefficient.

Proposed large-scale mining of Cambrian alum-shale in the Ranstad area in southern Sweden to extract uranium will affect natural groundwater conditions partly as a change in the recharge and partly as a lowering of piezometric head. The possible effects were estimated by analytical calculations and numerical methods in sections across the mountain within the mining area. The direct influence of the mining will be a lowering of the piezometric head in the limestone aquifer. The recharge to the sandstone will cease below the mined areas. Leachates from tailing disposals theoretically may cause increasing amounts of some components in the groundwater; however, this increase is small when compared to the natural variations in groundwater quality as measured by the regional inventory of wells. (See also W87-09568) (Geiger-PTT)
W87-09570

5D. Waste Treatment Processes

RECOVERY OF ORGANICS FROM TAILINGS POND SLUDGE USING COKE FOR AGGLOMERATION,
National Research Council of Canada, Ottawa (Ontario). Div. of Chemistry.
A. Kumar, B. D. Sparks, and A. Majid.
Separation Science and Technology SSTEDS, Vol. 21, No. 3, p 315-326, May 1986. 7 fig, 2 tab, 20 ref.

Descriptors: *Agglomeration, *Wastewater treatment, *Organic compounds, *Sludge, *Coke, Wastewater, Recovery, Ponds.

The effect of various process variables on the recovery of organics from sludge using an agglomeration technique was studied. Factorial design procedures were used to determine the important variables and their interactions on recovery of organics. It was observed that higher amounts and smaller particles of coke produced higher recoveries. A reasonable correlation between the surface area of coke and recovery of organics was observed. Furthermore, significant improvements in recoveries were obtained by using inexpensive additives during agglomeration. (Author's abstract)
W87-08602

WASTEWATER TREATMENT SYSTEM APPLYING AERATION-CAVITATION FLOTATION MECHANISM,
Tokyo Univ. (Japan). Dept. of Mineral Development Engineering.
M. Nonaka.
Separation Science and Technology SSTEDS, Vol. 21, No. 5, p 457-474, July 1986. 7 fig, 16 ref.

Descriptors: *Wastewater treatment, *Aeration, *Cavitation, *Flotation, Cost analysis, Separation technology, Energy, Performaance evaluation.

A new type of wastewater treatment system applying not only aeration but also the cavitation flotation mechanism is proposed to attain high capacity and low operation cost. The system can be operated continuously in a single or multistage with ease. The system is composed of four isolated sections: feed section, aeration section, multiphase flow sections, and separation section. Aeration and gas dissolution are carried out in the aeration section. Then collisions between the elements to be removed and gas bubbles, and cavitation of dissolved gas are accomplished in the multiphase flow section, followed by the recovery of the aggregates as the froth product in the separation section. The function of each section is evaluated by taking into consideration the contribution to the separation characteristics. It is confirmed through a series of treatment tests that the separation rate is a few tens of times faster than those in conventional treatment systems and, hence, lower energy consumption is anticipated in the proposed system. (Author's abstract)
W87-08603

REMOVAL OF TRACES OF PENTACHLOROPHENOL FROM AQUEOUS ACIDIC SOLUTIONS BY SOLVENT EXTRACTION AND SOLVENT SUBLATION,
Arkansas Univ., Fayetteville. Dept. of Chemical Engineering.
K. T. Valsaraj, and C. Springer.
Separation Science and Technology SSTEDS, Vol. 21, No. 6, p 789-807, October 1986. 4 fig, 4 tab, 22 ref.

Descriptors: *Pentachlorophenol, *Aqueous solutions, *Wastewater treatment, *Solvent extraction, *Solvent sublation, Separation technology, Sublation, Phenols, Organic compounds, Aeration.

The removal of pentachlorophenol (a hydrophobic compound of low vapor pressure) from aqueous acidic solutions was studied using solvent sublation (a surface chemical technique) and solvent extraction. Both methods gave appreciable removals in highly acidic solutions (pH = 2.5), but solvent sublation had the added advantage of minimal phase contact of the organic solvent with water and increased removals under certain circumstances. Solvent sublation was also found to be more effective than conventional fine bubble aeration. The removal of pentachlorophenol (PCP) was considerably smaller at pH's near the pKa of PCP. PCP removal by solvent sublation was enhanced by increasing ionic strength and also by the presence of small amounts of an ionic surfactant in the aqueous phase. The technique of solvent sublation was tried on an actual wastewater sample from a wood preserving industry. pH adjustment, removal of suspended solids, addition of sodium chloride, and subsequent solvent sublation into mineral oil reduced the PCP concentration in the aqueous waste by 99.7%. (Author's abstract)
W87-08605

SEPARATION OF MERCURY FROM AQUEOUS MERCURIC CHLORIDE SOLUTIONS BY ONION SKINS,
Osaka Prefecture Univ., Sakai (Japan). Dept. of Chemical Engineering.
S. Asai, Y. Konishi, and H. Tomisaki.
Separation Science and Technology SSTEDS, Vol. 21, No. 6, p 809-821, October 1986. 3 fig, 2 tab, 7 ref.

Descriptors: *Water treatment, *Mercury, *Wastewater treatment, *Aqueous solutions, *Onion skins, Separation technology, Ion exchange, Adsorption, Heavy metals, Equilibrium.

The separation of mercury from aqueous HgCl2 solutions by onion skins (outermost coat) was studied both experimentally and theoretically. The distribution equilibria were measured by the batchwise method. The experimental results revealed that onion skin is a useful material for separating mercury from aqueous systems. The distribution data obtained at 25 C were analyzed by using the theory based on the law of mass action. The separation of dissolved mercury by onion skins was found to be a process accompanied by an ion-

exchange reaction of the cationic complex HgCl(+) and an adsorption of the neutral complex HgCl2. The equilibrium constants of the ion-exchange and adsorption processes at 25C and the mercury-binding capacity of onion skins were determined. Further, it was found that the distribution equilibrium of mercury is comparatively insensitive to temperature. (Author's abstract)
W87-08606

STUDIES ON WATER HYACINTH AS A BIOLOGICAL FILTRE FOR TREATING CONTAMINANTS FROM AGRICULTURAL WASTES AND INDUSTRIAL EFFLUENTS,
Regional Research Lab., Hyderabad (India).
K. Jamil, S. S. Madhavendra, M. Z. Jamil, and P. V. R. Rao.
Journal of Environmental Science and Health (B) JPFCD2, Vol. 22, No. 1, p 103-112, February 1987. 5 fig, 16 ref.

Descriptors: *Agricultural wastes, *Industrial wastewater, *Water hyacinth, *Wastewater treatment, *Biological wastewater treatment, Aquatic plants, Effluents, Growth, Acidity, Heavy metals.

The aquatic weed - water hyacinth (Eichhornia crassipes (Mart) Solms) showed a remarkable capacity to withstand the effects of pH changes ranging from 5 to 8 in the aquatic environment. Growth continued to be normal except when placed for longer periods in medium containing iron ions at pH 3.3. The ability of this plant to neutralize some very acid solutions of heavy metals such as salts of copper, cadmium and zinc individually and in combinations, is being reported. Plants placed in pure acid and alkali solutions were also able to neutralize the medium. Calcium appears to play an important role in the mechanism involved in the adaptability of these plants to such environments. (Author's abstract)
W87-08609

AMMONIA, HYDROGEN SULPHIDE AND METHYL MERCAPTIDES IN FINNISH MUNICIPAL SEWAGE PLANTS AND PUMPING STATIONS,
Regional Inst. of Occupational Health, Kuopio (Finland).
J. Kangas, A. Nevalainen, A. Manninen, and H. Savolainen.
The Science of the Total Environment STENDL, Vol. 57, p 49-55, December 1986. 3 fig, 1 tab, 20 ref.

Descriptors: *Ammonia, *Hydrogen sulfide, *Methyl mercaptides, *Wastewater treatment facilities, *Pumping plants, Sludge, Wastewater treatment, Methane, Health hazards.

Ammonia, methane, hydrogen sulfide and methyl mercaptides were analyzed in the atmospheres of 16 Finnish municipal waste water treatment plants and in 18 pumping stations. The sulfides were analyzed on site as it was found that, with the standard 0.5-L laminated plastic bags, significant amounts of the vapors were lost from the gas phase. The relative humidity of the samples air was the most likely cause. Under normal operating conditions, sulfides varied from < 0.07 to 53 microgram(ug)/L, with highest concentrations found at the sludge presses. Pumping stations had sulfide vapors from 0.07 to 0.5 ug/L. The presence of ammonia (0.007-3.5 ug/L) and methane (0.7-18 ug/L) confirmed the hypothesis of the anaerobic origin of the offensive gases. Although more effective ventilation without scrubbing the emission gases would reduce the health hazard in the plants it would burden the environment. (Author's abstract)
W87-08725

MOVEMENT OF OLIGOTROPHIC BACTERIA IN ACTIVATED SLUDGE,
Tokyo Univ. of Agriculture (Japan). Dept. of Brewing and Fermentation.
R. Takahashi, T. Tsuda, T. Kajikawa, M. Suzuki, and H. Yoneyama.
Hakkokogaku Kaishi, Vol. 64, No. 5, p 437-441, 1986. 1 fig, 5 tab, 10 ref.

Descriptors: *Bulking sludge, *Oligotrophic bacteria, *Activated sludge, *Wastewater treatment, Cultures, Sugars, Bulking, Bacteria.

Numbers and kinds activated sludge bacteria in a practical plant grown on full-strength agar medium and its 100-fold dilution were counted and related to their sludge volume indexes (SVI). Below 160 of the SVI, activated sludge samples contained large numbers of oligotrophic bacteria, which grow on the 100-fold dilution medium, and the ratios of the number of oligotrophs to the number of cells grown on full-strength medium was 1.6 to 2.9. This ratio decreased above 160 of the SVI. The numbers of oligotrophic bacteria in an experimental activated sludge which was cultivated with artificial wastewater containing sugar, decreased rapidly before bulking. These findings suggested that the bacterial constitution of activated sludge would be changed appreciably before sludge bulking. (Author's abstract)
W87-08771

BIODEGRADATION OF PHENOLS IN AN INTEGRATED ACTIVATED CARBON BED AND SUSPENDED AEROBIC BIOLOGICAL GROWTH REACTOR,
National Univ. of Singapore. Dept. of Civil Engineering.
W. J. Ng.
Agricultural Wastes AGWADL, Vol. 18, No. 2, p 163-170, 1986. 2 fig, 2 tab, 6 ref.

Descriptors: *Biodegradation, *Phenols, *Activated carbon, *Aerobic conditions, *Wastewater treatment, *Biological wastewater treatment, Sugars, Effluents, Chemical oxygen demand.

A continuous aerobic bioreactor which combined an activated carbon bed and suspended biological growth was used to degrade a synthetic feed composed of glucose (400 mg/cu dm) and four phenolic compounds - phenol, o-cresol, m-cresol and p-nitrophenol (each, 50 mg/cu dm). Steady-state COD removals ranged from 84% to 95% of feed COD. Phenolic compounds in the effluent were not detectable. The system was found to be stable when treating feed with a COD ranging from 460 to 688 mg/cu dm. Total phenol removal was 2.34 g/cu dm reactor/day. (Author's abstract)
W87-08774

ATTENUATION OF CD AND PB SOLUBILITY IN MUNICIPAL WASTE INCINERATOR ASH,
Tennessee Valley Authority, Muscle Shoals, AL. Office of Agricultural and Chemical Development.
For primary bibliographic entry see Field 5E.
W87-08776

PUERTO RICO SEEKS CLEAN WATER,
W. G. Reinhardt.
Engineering News Record ENREAU, Vol. 218, No. 13, p 21, 24, 25, March 1987.

Descriptors: *Wastewater treatment, *Costs, *Primary wastewater treatment, *Secondary wastewater treatment, *Construction costs, *Operating costs, Puerto Rico, Maintenance costs, Economic aspects, Financing, Wastewater, Wastewater facilities.

The Commonwealth of Puerto Rico is attempting to solve its wastewater problems with a short-term strategy which includes building primary plants along the Atlantic and Caribbean coasts. Eventually the plans call for upgrading to secondary treatment where tropical water quality standards require. Wastewater managers have applied for waivers of the 1988 secondary treatment requirements for 10 facilities and are using the funds saved by not building and operating those plants to upgrade treatment of sewage discharged into inland waterways which supply much of the drinking water for the island's rural poor. Construction costs and financing methods were discussed. (Wood-PTT)
W87-08802

APPLICATIONS OF POROUS MEMBRANES FOR BIOMASS RETENTION IN BIOLOGICAL WASTEWATER TREATMENT PROCESSES,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
G. K. Anderson, C. B. Saw, and M. I. A. P. Fernandes.
Process Biochemistry PRBCAP, Vol. 21, No. 6, p 174-182, December 1986. 11 fig, 3 tab, 6 ref.

Descriptors: *Biological wastewater treatment, *Retention, *Biomass, *Membrane processes, *Porous membranes, *Wastewater treatment, Biological treatment, Performance evaluation, Aerobic treatment, Anaerobic digestion, Bacteria, Oxygen demand, Chemical oxygen demand, Methane, Sedimentation, Filtration, Ultrafiltration, Optimization, Suspended solids.

A new concept for operating completely mixed biological wastewater treatment systems is proposed, whereby porous membranes are used for retaining a high concentration of biomass in reactors. Experimental results from a two-phase anaerobic digester using porous membranes are presented. The membrane-aided reactor is capable of achieving more than 98% COD removal at an overall organic loading rate of about 10.8 kg COD/cu m/d. Methane production varied from 0.30 to 0.35 cu m/kg COD removed at STP. The system was tolerant to variations in influent characteristics and exhibited stability during load changes. Maximum biomass used was 33,000 mg/l. Due to adhesion of a thin layer of biomass on the 90-micron membrane, effluent suspended solids concentrations were consistently below 50 mg/l. The decrease in flux was mainly due to the increase in suspended solids in the reactor, as well as to entrapment of biomass within the membrane in the long term. The use of external crossflow filtration units may provide a more positive control of membrane fouling. It is concluded that the membrane-aided reactor may solve the problems of separating solids for the production of a clear final discharge effluent and for solids recycle to maintain a satisfactory biomass concentration in the reactor. (Author's abstract)
W87-08889

ANAEROBIC TREATMENT OF DISTILLERY SLOPS USING AN UPFLOW ANAEROBIC FILTER REACTOR,
NSTA-ASEAN Biogas Project, Manilla (Philippines).
C. M. Silverio, P. G. Anglo, G. V. Montero, M. V. Pacheco, and M. L. Alamis.
Process Biochemistry PRBCAP, Vol. 21, No. 6, p 192-195, December 1986. 6 fig, 1 tab, 8 ref.

Descriptors: *Wastewater treatment, *Food-processing wastes, *Anaerobic digestion, *Upflow anaerobic filters, *Filtration, *Biological wastewater treatment, *Resource recovery, *Methane, Performance evaluation, Filters, Biodegradation, Digestion, Industrial wastes, Oxygen demand, Chemical oxygen demand, Retention time, Suspended solids, Hydrogen ion concentration, Alkalinity, Ammonia.

A study was conducted on the anaerobic treatment of molasses distillery slops using an upflow anaerobic filter packed with red bricks. At the highest organic concentration tested (80 g COD/l), a daily biogas yield of 2 liters per liter of effective digester volume was obtained at a hydraulic retention time of 9 days. At an initial organic concentration loading of 40 g COD/l, COD removal decreased as loading increased. Total solids reduction ranged from 45% to 65%. The stepwise increase in hydraulic loading rate from 0.6 to 1.5 liters per day markedly increased the daily gas production from 5.5 to 17 liters per liter of substrate per day, despite a corresponding reduction in hydraulic retention time from 9 to 3.6 days. However, the reduction in hydraulic retention time resulted in a decrease in the organic removal efficiency of the wastewater. The pH of the effluent was fairly stable at 6.7-7.0. Fluctuation in pH was minimized by the buffering capacity provided by an increase in alkalinity accompanying the increase in hydraulic loading rate. (Author's abstract)
W87-08890

BIOLOGICAL DENITRIFICATION OF A HIGHLY NITROGENOUS INDUSTRIAL EFFLUENT: A CASE STUDY IN ZIMBABWE,
Zimbabwe Univ., Mount Pleasant. Dept. of Land Management.
K. W. Nyamapfene, and E. G. Mtetwa.
Environmental Pollution, Vol. 44, No. 2, p 119-126, 1987. 2 fig, 1 tab, 8 ref.

Descriptors: *Industrial wastewater, *Denitrification, *Biological wastewater treatment, *Wastewater treatment, *Zimbabwe, *Nitrogen, Effluents, Catchment areas, Reservoirs, Regulations.

This paper describes the establishment and design of a scheme to denitrify industrial effluent with concentrations of N greater than 2000 mg/L to levels within the regulatory limits of the Zimbabwe Natural Resources Act which stipulates an upper limit of 10 mg/L of nitrate in effluent dumped in important catchment areas. The scheme was set up in 1978 and the data used in the discussion are for the year 1983, five years after the establishment of the scheme. The scheme consists of three impounding reservoirs in which effluent is held for at least 24 h in each case so that it undergoes biological denitrification at each stage. In some cases, the effluent is diverted after the second reservoir and is used to irrigate pastures on which dairy cattle are being grazed. In general, under this scheme, the N content of the effluent is within the regulatory limit by the time it enters the main river system, about 8 km away. (Author's abstract)
W87-08964

HANDBOOK OF CHLORINATION,
G. C. White.
Second Edition. Van Nostrand Reinhold Co., New York, NY. 1986. 1070 p.

Descriptors: *Handbooks, *Chlorination, *Water treatment, *Wastewater treatment, *Disinfection, Potable water, Industrial water, Chloramines, Chlorine dioxide, Ozone, Bromine, Iodine, Ultraviolet radiation.

Chlorine has ben the most prevalent means of disinfecting water for over a century. However, in recent years, there has been a growing concern about adverse effects of compounds found in water treated with chlorine. More than a decade has passed since this useful handbook was first published in 1972. Since then, the public has witnessed more interest, more development, more controversy, and more published documents on the subject of chlorine than were seen during the preceding fifty years. Clearly explained is the chlorination of potable water, wastewater, and industrial water. Focus is on the chlorination/dechlorination process, presenting significant new material, and exploring alternative methods to chlorination for disinfection. The alternatives covered in detail are chloramines, or chlorine dioxide, ozone, bromine, iodine, and UV radiation. (Lantz-PTT)
W87-09064

APPLIED STREAM SANITATION,
For primary bibliographic entry see Field 2H.
W87-09189

MANAGEMENT OF INDUSTRIAL POLLUTANTS BY ANAEROBIC PROCESSES,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
A. W. Obayashi, and J. M. Gorgan.
Industrial Waste Management Series. Lewis Publishers, Inc., Chelsea, MI. 1985. 193 p. Series Edited by James W. Patterson.

Descriptors: *Industrial wastes, *Anaerobic digestion, *Waste management, *Waste treatment, Fermentation, Toxicity, Sulfur, Biodegradation, Environmental effects.

This volume is of particular interest to those industrial and environmental engineers who are familiar with fermentation and similar anaerobic process technology and its economic potential, and who seek to identify opportunities for application of this technology in industrial waste management. The volume incorporates a diverse spectrum of information, including an overview of anaerobic technology in its various configurations, as well as their applications for industrial pollutants, and associated toxicity effects. The volume also presents, by way of example, an innovative recovery application to sulfur waste management. This comprehensive volume brings together information on current and potential applications of anaerobic processes in industrial waste management. (Lantz-PTT)
W87-09190

ECONOMICS OF THE TREATMENT OF DAIRY COW SLURRY BY ANAEROBIC DIGESTION,
Operational Research Group, Silsoe (England).
D. J. Parsons.
Journal of Agricultural Engineering Research JAERA2, Vol. 35, No. 4, p 259-276, December 1986. 1 fig, 18 tab, 19 ref, 1 append.

Descriptors: *Wastewater treatment, *Economic aspects, *Animal wastes, *Dairy industry, *Cattle, *Anaerobic digestion, *Cost analysis, *Slurries, Digestion, Biodegradation, Biological treatment, Prices, Retention time, Technology, Separation techniques, Heat exchangers, Temperature, Costs.

The cost of treating dairy cow slurry by anaerobic digestion was calculated using the value of the energy produced to offset the running costs. The impact of technical changes was evaluated, including four retention times, pre-treatment separation, reduction in water entering the slurry, use of an effluent-influent heat exchanger, three operating temperatures, and improved gas yield. The effects of changes in energy prices and component costs were considered. The results are presented as average annual costs for operating the systems over a 10-year period at given levels of energy utilization and price. The annual cost of anaerobic digestion with present technology ranges from 9 pounds/cow to 70 pounds/cow, making it uneconomic when considered solely as a source of energy. Lower costs may be achieved by combining several technical and operational improvements. The importance of keeping the digester in operation for the full year is shown. The best methods of improving the economics of anaerobic digestion are good waste management to maintain a high slurry dry matter and increasing the gas yield at short retention times. (Author's abstract)
W87-09216

CHEMICAL CHANGES OF ORGANIC COMPOUNDS IN CHLORINATED WATER: XII. GAS CHROMATOGRAPHIC-MASS SPECTROMETRIC STUDIES OF THE REACTIONS OF METHYLNAPHTHALENES WITH HYPOCHLORITE IN DILUTE AQUEOUS SOLUTION,
Tokyo Univ. of Science (Japan). Faculty of Pharmaceutical Sciences.
For primary bibliographic entry see Field 2K.
W87-09224

REMOVAL OF PHENOLS BY ADSORPTION ON FLY ASH,
Dept. of Chemical Engineering and Technology, Inst. of Technology, Banaras Hindu Univ., Varanasi - 221005, India.
S. Kumar, S. N. Upadhyay, and Y. D. Upadhya.
Journal of Chemical Technology and Biotechnology JCTBDC, Vol. 37, No. 4, p 281-290, April 1987. 6 fig, 3 tab, 25 ref.

Descriptors: *Phenols, *Wastewater treatment, *Fly ash, *Adsorption, Isotherms, Acitivated carbon.

Adsorption of phenol and cresol and their mixtures from aqueous solutions on activated carbon and fly ash has been investigated. The effects of contact time and initial solute concentration have been studied and isotherm parameters are evaluated. The Freundlich isotherm has been found to be more suitable for all the systems investigated. The results of the present batch studies show that adsorption of phenols on fly ash is quite satisfactory; however, the contact times required to reach equilibrium are larger in comparison with those for activated carbon. The general trends of the results for both adsorbents are more or less identical. The fairly steep nature of the Freundlich isotherms for fly ash gives a positive indication regarding its use in column adsorbers. (Alexander-PTT)
W87-09250

STUDY OF THE KINETICS OF THE ADSORPTION BY ACTIVATED CARBONS OF 2,4,5-TRICHLOROPHENOXYACETIC ACID FROM AQUEOUS SOLUTION,
Departamento de Quimica Inorganica, Facultad de Ciencias, Universidad de Granada, 18071-Granada, Spain.
L. Gomez-Jimenez, A. Garcia-Rodriguez, J. de Dios Lopez-Gonzalez, and A. Navarrete-Guijosa.
Journal of Chemical Technology and Biotechnology JCTBDC, Vol. 37, No. 4, p 271-280, April 1987. 6 fig, 4 tab, 19 ref.

Descriptors: *Wastewater treatment, *Adsorption, *Activated carbon, *Kinetics, *Phenoxyacetic acids, Herbicides, Pesticides, Desorption.

The kinetics of the adsorption of 2,4,5-trichlorophenoxyacetic acid by activated carbons from an aqueous solution has been studied at several temperatures (10 C to 50 C). The activated carbons used were Merck (No. 2514) and one prepared from almond shells (C-A-14). The adsorption process seems to be of the order two and the desorption of the order one. The thermodynamic functions for the formation of the activated complex have also been calculated. (See also W87-09254) (Author's abstract)
W87-09251

ADSORPTION OF 2,4,5-T BY ACTIVE CARBONS FROM AQUEOUS SOLUTION,
Departamento de Quimica Inorganica, Facultad de Ciencias, Universidad de Granada, 18071-Granada, Spain.
L. Gomez-Jimenez, A. Garcia-Rodriguez, J. de Dios Lopez-Gonzalez, and A. Navarrete-Guijosa.
Journal of Chemical Technology and Biotechnology JCTBDC, Vol. 38, No. 1, p 1-13, May 1987. 8 fig, 6 tab, 13 ref.

Descriptors: *Wastewater treatment, *Adsorption, *Trichlorophenoxyacetic acid, *Activated carbon, Isotherms, Herbicides, Pesticides, Model studies, Surface area.

The adsorption isotherms of 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) on activated carbons from aqueous solution have been obtained at several temperatures (10 to 50 C). The activated carbons used were Merck (No. 2514) and another one prepared from almond shells (C-A-14). Monolayer capacities, X sub M, were obtained by applying different theoretical models, such as BET, Langmuir and Lopez-Gonzalez, to data. The X sub M values were of the order of .001 mol/g, being the lowest corresponding to the Merck sample. Surface areas of the two carbon samples, accessible to the molecules of 2,4,5-T, have also been determined as well as some thermodynamic data corresponding to the adsorption process. (See also W87-09251) (Author's abstract)
W87-09254

STROBOSCOPIC DETERMINATION OF SETTLING VELOCITY, SIZE AND POROSITY OF ACTIVATED SLUDGE FLOCS,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W87-09263

BIODEGRADABILITY OF PARA-DICHLOROBENZENE AND ITS BEHAVIOUR IN MODEL ACTIVATED SLUDGE PLANTS,
Unilever Research, Port Sunlight Lab., Quarry Road East, Bebington, Wirral, Merseyside L63 3JW, U.K.
B. Topping.

Water Research WATRAG, Vol. 21, No. 3, p 295-300, March 1987. 7 fig, 5 tab, 16 ref.

Descriptors: *Fate of pollutants, *Biodegradation, *Dichlorobenzene, *Wastewater treatment, *Activated sludge, *Bacteria, Volatilization, Acclimatization, Organic compounds.

Confirmation of the ready and ultimate biodegradation of para-dichlorobenzene (pDCB) was obtained from the Organisation for Economic Cooperation and Development (OECD) closed bottle test. The fate of pDCB during primary sedimentation of raw sewage was investigated in a simple laboratory study, and the results indicated that the major proportion of the material (>67%) remained in the supernant liquor, and would therefore undergo biological treatment. The removal of pDCB in the OECD confirmatory test was found to be consistently high (97.1 + or - 2.3%). Mass balance results indicated that, at a high aeration rate (2 L/min), the major mechanism for removal of pDCB was volatilization (66.6 + or - 19.3%). The fate of pDCB in a modified porous pot test, operated at a lower aeration rate, and at temperatures of 8, 15, and 20 C and sludge retention times (SRT) of 3 and 6 days, was also investigated. Once again the overall removal was found to be consistently > 95%. Mass balance results suggested that, under normal operating conditions, the major proportion of pDCB (> 76%) had been removed by biodegradation. The amount of pDCB removed by volatilization showed a slight dependence on aeration rate, but only became significant (63 + or - 4%) when adverse operating conditions prevailed (i.e., 8 C, at a 3 day SRT). Radioisotopic studies confirmed the presence of pDCB degrading bacteria in activated sludge taken from a porous pot continuously dosed with pDCB. The results of a similar test using sludge from an undosed porous pot suggested that acclimatization to pDCB was rapid, occurring within 2 days. No adverse effects on sewage treatment processes, due to the presence of pDCB, were observed. (Author's abstract)
W87-09269

ENHANCED UPTAKE OF PHOSPHORUS BY ACTIVATED SLUDGE - EFFECT OF SUBSTRATE ADDITION,

Toronto Univ. (Ontario). Dept. of Civil Engineering.
P. H. Jones, A. D. Tadwalkar, and C. L. Hsu.
Water Research WATRAG, Vol. 21, No. 3, p 301-308, March 1987. 10 fig, 4 tab, 19 ref.

Descriptors: *Phosphorus removal, *Wastewater treatment, *Biological wastewater treatment, *Bioaccumulation, *Substrates, Nutrients, Aeration.

Studies were undertaken to examine the effect of substrate addition upon the release and subsequent uptake of phosphorous by a biological wastewater treatment laboratory scale system. A train of six reactors were fed at a rate of 16 ml/min raw wastewater using a sludge recycle ratio of 0.75 (12 ml/min). The first two reactors were simply stirred (anoxic) without the addition of air and the remaining four were aerated with excess air. Various substrates were added to the first reactor (anoxic) at different concentrations. It was determined that all the short chain substrates tested enhanced the release of phosphorus in the anoxic stages and subsequently led to increased biological uptake (removal) of phosphorus. The substrates tested included sodium acetate, acetic acid, butyric acid, ethanol and methanol. It was determined that 30 mg/l sodium acetate was the optimum dose for biological release and uptake of phosphorus and the addition of any greater concentration had marginal effect on the ultimate removal of phosphorus. The effect of these substrates showed some specificity regarding phosphorus release, with butyric acid causing the greatest release and sodium acetate the least. However as far as phosphorus uptake (removal) was concerned, this phenomenon of substrate-specificity was less significant. For all substrates, effluent phosphorus concentration was within + or - 1 mg/l with an approximate mean concentration of 1 mg/l residual. Phosphorus released (approx. 14 mg/l) at higher temperature (29 C) was 75% greater than at the lower temperature (24 C). Similarly the final residual phosphorus at 29 C was 33% lower than at 24 C. (Author's abstract)
W87-09270

METHANOGENIC TOXICITY AND ANAEROBIC DEGRADABILITY OF A HYDROLYZABLE TANNIN,

Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
J. A. Field, and G. Lettinga.
Water Research WATRAG, Vol. 21, No. 3, p 367-374, March 1987. 5 fig, 5 tab, 40 ref.

Descriptors: *Wastewater treatment, *Methane bacteria, *Toxicity, *Activated sludge, *Gallotannic acid, *Tannins, *Anaerobic digestion, Bacteria, Monomers, Polymers, Adsorption.

Gallotannic acid was found to be highly toxic to methanogenic activity. Concentrations, representing 50% inhibition, approximated 700 mg/l. The toxicity was persistent despite the rapid degradation of gallotannic acid to volatile fatty acids and methane. A 72.5% loss of sludge activity was associated with a 1 day exposure of methanogenic granular sludge to 1000 mg/l gallotannic acid. The toxicity of gallotannic acid was persistent over 2 month assay periods. The monomeric derivatives of gallotannic acid, gallic acid and pyrogallol were much less toxic. The 50% inhibition concentration of the monomers approximated 3000 mg/l and their toxicities were not persistent. No activity losses were evident after sludge was exposed to 3000 mg/l gallic acid for 19 days. The lower toxicities of the monomers compared to the gallotannic acid polymer suggests that the mechanism of toxicity was 'tanning', since data in the literature indicate that tannin polymers are more effectively adsorbed and precipitated with proteins compared to their monomeric counterparts. Functional proteins (enzymes) located at accessible sites in or on the methane bacteria are most likely disturbed by the tanning action. (Author's abstract)
W87-09278

DESORPTION AND REGENERATION OF DYE COLOURS FROM LOW-COST MATERIALS,

Dept. of Chemical Engineering, The Queen's Univ. of Belfast, Belfast BT9 5DL, Northern Ireland.
G. McKay, G. Ramprasad, and P. Mowli.
Water Research WATRAG, Vol. 21, No. 3, p 375-377, March 1987. 1 tab, 7 ref.

Descriptors: *Wastewater treatment, *Adsorption, *Clay, *Dyes, *Desorption, Regeneration, Costs, Sorption, Ion exchange.

Experimental methods and results are reported on the desorption and regeneration of eight dye colors individually from six low-cost sorbent materials. Desorption and regeneration values give an idea about the type of interaction between the sorbate and the sorbent, and the possibility of regeneration of the sorbent. Bentonite clay, amongst the six low-cost materials studied in the present investigation, could sorb all the dyes used in investigation with the exception of the acid dyes. No regeneration of clay is possible in the sorption of dyes, since strong chemical bonding occurs between it and the sorbed dyes. Rice husk, bark, cotton waste and hair could sorb only the red and blue basic dyes and a combination of ion-exchange and chemical bonding occurs in the sorption process. (Author's abstract)
W87-09279

DESIGN AND USE OF PRESSURE SEWER SYSTEMS,

Thrasher Engineering, Rogers, AR.
D. Thrasher.
Lewis Publishers, Inc., Chelsea, MI. 1987. 124 p.

Descriptors: *Hydraulic engineering, *Sewers, *Structures, *Pressure sewers, *Wastewater disposal, *Wastewater transport, Cost analysis, Economic aspects, Design standards, Maintenance, Structural engineering.

Currently, the field of wastewater engineering is in an extremely dynamic period of development. Due to the high cost of wastewater collection systems, engineers are reevaluating old ideas concerning wastewater collection and new concepts are being formulated. The traditional model of collection for wastewater has been gravity sewers. One problem with this traditional solution has been the obvious fact that gravity sewers must slope downhill. This creates a situation where deep cuts are often required and large, expensive pump stations are often necessary. For most wastewater disposal projects, the collection system is usually by far the most expensive portion of the project, while the treatment plant is usually a comparatively small expense. Since most on-site wastewaater disposal systems cost significantly less than centralized sewer, the on-site approach has been generally employed in areas where on-site disposal is applicable. Difficulties have arisen in areas where conventional on-site systems have failed due to unfavorable soil conditions. For an area that is not conducive to the on-site disposal of human waste and cannot afford the high cost of conventional wastewater collection systems, innovative collection alternatives should be considered. One such alternative to consider should be a pressurized sewer system. The purpose of this book is to provide the reader with an overview of the design and use of pressure sewer systems, by consolidating the existing literature, along with the author's experience, into a single reference. (Lantz-PTT)
W87-09309

BIOFILM SHEARING UNDER DYNAMIC CONDITIONS,

Univ. of Houston, Environmental Engineering Program, Houston, TX 77004.
G. E. Speitel, and F. A. DiGiano.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 3, p 464-475, June 1987. 7 fig, 3 tab, 9 ref. NSF Grant CEE-8213418.

Descriptors: *Model studies, *Biofilm, *Shearing, *Packed columns, *Activated carbon, *Wastewater treatment, *Biodegradation, Growth, Microbiological studies, Regression analysis, Substrates.

Experimental data on biofilm shearing were collected for columns packed with granular activated carbon. The columns were operated under dynamic conditions, experiencing a wide range of biodegradation rates. Under conditions of rapidly changing biodegradation rate, biofilm shearing was much more closely related to the microbial growth rate than to the amount of attached biomass, as had been previously proposed. A two-term model of biofilm shearing was proposed and described the data well. The first term is a proportionality between shearing and microbial growth rate, exclusive of loss mechanisms. The two parameters in the model were evaluated by linear regression analysis of specific shearing rate versus specific growth rate. Parameter values were determined for the substrates, phenol and paranitrophenol. The value of the growth-related shearing parameter appeared to have a significant substrate dependence. Substantial biofilm shearing occurred during periods of rapid biodegradation, demonstrating the importance of this process in attached growth reactors. (Author's abstract)
W87-09367

METAL PRECIPITATION IN TWO LANDFILL LEACHATES,

Michigan Univ., Ann Arbor.
For primary bibliographic entry see Field 5G.
W87-09368

PREDICTION OF FIXED-BED ADSORBER REMOVAL OF ORGANICS IN UNKNOWN MIXTURES,

Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
J. C. Crittenden, P. Luft, and D. W. Hand.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 3, p 486-498, June 1987. 5 fig, 2 tab, 20 ref. NSF Grant CEE-8300213.

Descriptors: *Wastewater treatment, *Adsorption, *Model studies, *Organic compounds, Prediction, Mixtures, Solutes, Breakthrough, Equilibrium.

A method is proposed to predict fixed-bed adsorber removal of individual organic compounds and surrogate parameters such as total organic halogen (TOX or TOC) in the presence of an unknown adsorbing mixture by representing the adsorption behavior of the unknown mixture as one or two hypothetical components (HCs). The equilibrium parameters, concentrations and mass transfer parameters of the HCs are determined by comparing the behavior of a known compound in experiments with the unknown mixture to single solute experiments. The HC properties that are determined in this manner are then used in a mathematical model of fixed-bed adsorption to predict the breakthrough of TOX and individual compounds in the unknown mixture. This HC procedure is verified by the satisfactory agreement of fixed-bed predictions with fixed-bed data for six synthetic organic compounds and TOX in an unknown mixture. (Author's abstract)
W87-09369

RATIONAL DESIGN OF AEROBIC DIGESTION SYSTEM,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
L. G. Rich.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 3, p 499-515, June 1987. 4 fig, 23 ref.

Descriptors: *Design criteria, *Wastewater treatment, *Aerobic digestion, Stabilization, Activated sludge, Performance evaluation.

Deficiencies are identified in state-of-the-art procedures used in the design of systems for the aerobic digestion of waste-activated sludge solids. A procedure not only includes a well-defined stabilization objective, but takes into account the stabilization that occurs in the activated sludge process. Related methods are discussed by which coefficients used in the design procedure can be evaluated. A design example is given. Further research and performance data derived from systems designed by the procedure are needed to better evaluate the parameters used and to test the assumptions made in applying the procedure. (Author's abstract)
W87-09370

EXPANSION OF GRANULAR FILTERS DURING BACKWASHING,
Dept. of Civil Engineering, Fac. of Engineering and Technology, Univ. of Jordan, Amman, Jordan.
I. Sholji.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 3, p 516-531, June 1987. 4 fig, 6 tab, 17 ref.

Descriptors: *Fluidization, *Water treatment, *Filters, *Wastewater treatment, *Backwashing, *Granular filters, *Model studies, Settling velocity, Flow, Prediction, Porosity, Fixed beds.

In practice, the analysis of fluidization problems, particularly in the backwashing of water filters, is generally carried out on the basis of empirical and semi empirical criteria. In this paper, Bond's hindered settling velocity is adapted since it is based on the continuity equation and applied to any hydraulic flow regime. The modification is based on simple physical conditions and accounts for the initial fixed bed, as well as the instantaneous backwashing conditions, e.g., porosity, physical conditions of backwashing fluid and grains, and the depth of bed. The present study describes the development of a new backwashing model applied to unisize granular media, particularly sand, and anthracite, and directly or indirectly incorporates variables such as flow conditions and physical properties (length, porosity, etc.) of the bed, which affect the backwashing process. In addition, the model predicts the value of the expanded length at any predetermined conditions. (See also W87-09372) (Author's abstract)
W87-09371

COMPARISON OF BACKWASH MODELS FOR GRANULAR MEDIA,
Dept. of Civil Engineering, Fac. of Engineering and Technology, Univ. of Jordan, Amman, Jordan.
I. Sholji, and F. A. Johnson.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 3, p 532-549, June 1987. 8 fig, 6 tab, 11 ref.

Descriptors: *Fluidization, *Water treatment, *Filters, *Wastewater treatment, *Backwashing, *Granular filters, *Model studies, Settling velocity, Flow, Prediction, Porosity, Fixed beds.

This work composes a general semiempirical formula of fluidization and theoretical and experimental models developed by the writers. Both mathematical approaches adopt unisize granular grains, but of different origins. The former relies on the assessment of the hydraulic flow conditions prevailing at the time of the tests, which incorporate values of both Reynolds number and n and lead to a value of n sub 1. The last three values are dependent on the defined mean value of the designated diameter. The later mathematical and experimental models account for all kinds and types of flow conditions, independent of any other mathematical relationships, and only consider the mean hydraulic diameter of the unisized grains. The other main section deals with the effect of the initial volumetric concentration of fluidized uniform particles or initial fixed bed porosities under the state of expansion or contraction of the fluidization determined by experiment. (See also W87-09371) (Author's abstract)
W87-09372

MODELING COLIFORM BACTERIA SUBJECT TO CHLORINATION,
Dept. of Civil Engineering, Univ. of Manitoba, Winnipeg, Manitoba, Canada, R3T 2N2.
D. H. Burn.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 3, p 585-594, June 1987. 2 tab, 11 ref.

Descriptors: *Wastewater treatment, *Chlorination, *Coliforms, *Model studies, Disinfection, Bacteria, Comparison studies.

The effects of chlorination on the decay characteristics of coliform bacteria were examined through the use of mathematical models. Four models were fit to data collected during periods for which the waste source was chlorinated and periods without chlorination. The optimal values of the model parameters, identified by the least squares technique, were compared for the two data sets to determine if a significant difference in behavior exists. It was concluded that the models that were fit to data corresponding to chlorinated wastes were different from the models that were fit to the data collected during non-chlorination events. (Author's abstract)
W87-09375

SEDIMENT DIFFUSION IN PRIMARY SHALLOW RECTANGULAR CLARIFIERS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W87-09376

POTASSIUM FERRIOXALATE AS CHEMICAL ACTINOMETER IN ULTRAVIOLET REACTORS,
HYA Consulting Engineers, 1010 S. Baldwin Ave., Arcadia, CA 91006.
For primary bibliographic entry see Field 5F.
W87-09377

BIODEGRADATION OF TRICHLOROETHYLENE AND INVOLVEMENT OF AN AROMATIC BIODEGRADATIVE PATHWAY,
Technology Applications, Inc., Gulf Breeze, FL 32561.
M. J. K. Nelson, S. O. Montgomery, W. R. Mahaffey, and P. H. Pritchard.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 5, p 949-954, May 1987. 3 fig, 5 tab, 21 ref. EPA Interagency agreement FY 8952-85-1008 and Contract 68-03-6265.

Descriptors: *Wastewater treatment, *Fate of pollutants, *Biodegradation, *Trichloroethylene, *Phenols, *Aromatic compounds, Metabolism, Bacteria, Oxidation, Enzymes.

Biodegradation of trichloroethylene (TCE) by bacterial strain G4 resulted incomplete dechlorination of the compound, as indicated by the production of inorganic chloride. A component of the water from which strain G4 was isolated that was required for TCE degradation was identified as phenol. Strain G4 degraded TCE in the presence of chloramphenicol only when preinduced with phenol. Toluene, o-cresol, and m-cresol could replace the phenol requirement. Two of the inducers of TCE metabolism, phenol and toluene, apparently induced the same aromatic degradative pathway that cleaved the aromatic ring by meta fission. Cells induced with either phenol or toluene had similar oxidation rates for several aromatic compounds and had similar levels of catechol-2,3-dioxygenase. The results indicate that one or more enzymes of an inducible pathway for aromatic degradation in strain G4 are responsible for the degradation of TCE. (Author's abstract)
W87-09387

METHANE RECOVERY FROM WATER HYACINTH THROUGH WHOLE-CELL IMMOBILIZATION TECHNOLOGY,
Centre for Environmental Science and Engineering, Indian Inst. of Technology, Powai, Bombay, 400 076, India.
A. P. Annachhatre, and P. Khanna.
Biotechnology and Bioengineering BIBIAU, Vol. 29, No. 7, p 805-818, May 1987. 11 fig, 7 tab, 10 ref.

Descriptors: *Waste treatment, *Water hyacinth, *Methane, *Immobilization technology, Biogas, Alkali, Substrates.

The concepts of feed pretreatment, phase separation, and whole-cell immobilization technology have been incorporated in this investigation for the development of rational and cost-effective two- and three-stage methane recovery systems from water hyacinth (WH). Analyses of laboratory data reveal that a three-stage system could be designed with an alkali pretreatment stage (3.6% Na2CO3 + 2.5% Ca(OH)2 W/W, 24 h HRT) followed by an open acid reactor (2.1 days HRT) and closed immobilized methane reactor (12 h HRT), providing steady-state COD conversion of 62-65%, TVA conversion of 91-95%, and gas productivity of 4.08-5.36 L/L reactor volume/day with 82% methane. A gas yield of 50 L/kg WH/day (dry wt basis) at 35-37 C is possible with this system. Insulation bricks, with particle size distribution of 500-3000 micron, were used as support material in the reactors at organic loading rate of 20 kg COD/cu m day. The reactors matured in 15-18 weeks. Substantial reduction in retention time for the conversion of volatile acids in immobilized methane reactors prompted further research on the combined immobilized reactor to make possible an additional reduction in the cost of a WH-based biogas system. Evaluation of laboratory data reveals that a two-stage system could be designed with an open alkali pretreatment stage and a combined immobilized reactor (12 h HRT), providing steady-state COD conversion of 53% and gas productivity of 3.1 L/L reactor volume/day with 86% methane. A gas yield of 44 L/kg WH/day (dry wt basis) at 35-37 C could be obtained from this system. Insulation bricks, with 500-1000 micron particle size distribution, was used as support material at an organic loading rate of 15 kg COD/cu m day. Notwithstanding the fact that the technology in this study has been developed with water hyacinth as substrate, the implicit principles could be extended to any other organic substrate. (Author's abstract)
W87-09420

SCALE-UP OF WATER AND WASTEWATER TREATMENT PROCESSES.
Schmidtke (Norbert W.) and Associates Ltd., Kitchener (Ontario).

Papers presented at the First International Workshop on Scale-Up of Water and Wastewater Treatment Processes, March 1983, Edmonton, Alberta. Butterworth, Boston, 1983. Edited by Norbert W. Schmidtke and Daniel W. Smith. 447 p.

Descriptors: *Wastewater treatment, *Water treatment, *Scale effect, *Design criteria, Mixing, Aeration, Filtration, Oxygen transfer, Adsorption, Ion exchange, Kinetics, Activated sludge process, Biological wastewater treatment.

This book gathers the work of 40 authors and coauthors on the subject of scale-up and scale-down of water and wastewater treatment processes. Although the principles of scale adjustment have been used with varying degrees of success, sometimes distortion occurs. Theoretical studies and case histories point out the factors to consider in scale-up in many categories. The introductory section is concerned with basic principles. Among the topics covered under the main headings of gas transfer, liquid/solid separation, adsorption/ion exchange, chemical processes, and biological processes are aeration, filtration, sedimentation, fluidized beds, dewatering centrifuges, adsorption, ion exchange, radium removal from uranium mine wastewater, activated sludge systems (kinetics, single-stage systems, multi-stage systems, and treatment of cellulosic materials). Scale-up is important in designing full-scale plants from bench- and pilot-scale studies; scale-down is important in taking problems in full-scale plants to the laboratory-scale for study. (See W87-09432 thru W87-09455)
W87-09431

SCALE-UP AND SCALE-DOWN CONCEPTS AND PROBLEMS,
I. Horvath, and N. W. Schmidtke.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 3-10, 1 fig, 3 ref.

Descriptors: *Wastewater treatment, *Water treatment, *Scale effect, *Design criteria, *Industrial wastewater, Engineering, Boundary conditions, Model studies.

Much data has been generated on treatment processes for industrial wastewaters. However, its use in design is limited because the study conditions are divergent. Bench-, pilot-, and full-scale results cannot be compared without considering the effects of scale differences. Relationships between systems of differing scale can be established by applying the theory of similarity. The types of similarity especially pertinent to water and wastewater processes are geometric, kinematic, dynamic, chemical, biological, and thermal. Dimensional analysis can be used to define relevant similarity criteria with dimensionless numbers. Scale-up and scale-down may be associated with a variety of problems and objectives: investigations involving process feasibility and generation of design criteria, process response at different scales, and generalization of relationships which describe unit operations occurring in different reactors. Complete similarity between systems is not possible; therefore, the method of trivial modelling or partial similarity is used. This includes considering the scaling effects, breaking up a large problem into subdivisions, defining initial and boundary conditions, and recognizing interdependence among processes. (See also W87-09431) (Cassar-PTT)
W87-09432

INTRODUCTION TO SCALE-UP OF WATER AND WASTEWATER TREATMENT PROCESSES,
Schmidtke (Norbert W.) and Associates Ltd., Kitchener (Ontario).
N. W. Schmidtke, and D. W. Smith.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 11-30, 8 fig, 3 tab, 19 ref.

Descriptors: *Wastewater treatment, *Water treatment, *Scale effect, *Design criteria, *Dimensional analysis, Engineering, Mathematical models, Model studies, Pilot plants, Stochastic process, Aeration, Oxygen transfer, Rotating biological contactor, Filtration, Vacuum filtration.

Some popular approaches to modelling unit operations and processes in the water and wastewater treatment field are highlighted. The focus is on the use of dimensional analysis (still in its infancy) as a tool to define scale-up relationships. The scale-up functions may also be used in scale-down mode to bring a full-scale plant problem into the laboratory for study. Four basic approaches to process design have evolved: empirical design, semi-empirical design, mathematical modelling, and experimentally developed design criteria. Physical models include bench- and pilot-scale models; the applications and advantages of each are listed. Techniques used for development of scale-up models and process design information are divided into three categories: test extrapolation, deterministic modelling, and stochastic modelling. The concept of similitude and dimensional analysis revolve around dimensions, either explicit or law-derived. The development of a dimensionless group (dependent variable) which is related by a scale ratio to full size parameter (independent variable) assumes that the values measured on the model will be the same as the values measured on the prototype. The objective is to establish the dimensional considerations so that results from one physical system can be applied to a physically similar system at a different scale. Examples of scale-up are given: surface and diffused aeration, rotating biological contactor, and vacuum filtration. (See also W87-09431) (Cassar-PTT)
W87-09433

PERSPECTIVES ON THE SCALE-UP OF IMPELLER MIXERS,
Mixing Equipment Co., Rochester, NY.
J. Y. Oldshue.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 31-54, 18 fig, 9 tab, 10 ref.

Descriptors: *Wastewater treatment, *Fluid mechanics, *Water treatment, *Scale effect, *Design criteria, *Mixing, *Impellers, *Pilot plants, Engineering, Mathematical models, Model studies, Shear, Inertia, Viscosity, Gravity, Surface tension, Reynolds number, Froude number, Weber number, Heat transfer, Mass transfer, Fermentation, Flocculation, Tanks.

Since large mixing vessels differ in several important parameters from small vessels, process design must understand and account for the differences. The basics of fluid mixing, fluid shear rates, and fluid forces (inertia force applied by the mixer, opposed by viscous force, gravitational force, and surface tension force) are described. There is a greater variety of shear rates in large tanks than in small tanks. In general, the ratios of different parameters change during scale-up; there is no way to keep all the factors constant when any given scale-up parameter is held constant. Geometric similarity, dynamic similarity, and dimensionless groups are examined. Compared with a full-scale plant, a pilot plant has a much higher pumping capacity, a lower average impeller macroscale shear rate, and a higher maximum macroscale impeller shear rate. This geometric similarity is not applicable in this situation. To make a pilot plant most like the full-scale plant, either the fluid mixing parameters must be changed or the geometry of the pilot plant must be different from the full-scale plant. Examples are a gas-liquid transfer (as in fermentation) and flocculation. (See also W87-09431) (Cassar-PTT)
W87-09434

IMPORTANT ISSUES IN THE SCALE UP OF NEW PROCESSES,
Commonwealth Scientific and Industrial Research Organization, Clayton (Australia). Div. of Chemical and Wood Technology.
W. G. Raper.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 55-62, 4 fig, 10 ref.

Descriptors: *Wastewater treatment, *Water treatment, *Scale effect, *Design criteria, *Pilot plants, Engineering, Sirofloc process, Phosphorus removal, Water analysis, Magnetite, Flocculation.

Experiences encountered in the scale-up of several new processes are described. In each case the problem was caused by initially obscure factors which, when identified, were simple to correct and were not related to scale-up. A pilot plant for biological removal of phosphorous from domestic sewage produced 80%-90% nitrogen removal but highly variable phosphorous removal. Composite sampling and analysis showed that the influent COD:total nitrogen ratio showed values of 5-6, too low for efficient phosphorous removal. A rigorous sampling and analysis program prior to constructing the pilot plant could have reduced the cost of the project from $100,000 to $1,000. In the Sirofloc process for water treatment by magnetite particles, initial raw water analysis and laboratory jar test results were used to design a pilot plant. However, on-site analysis and jar tests showed unacceptably high levels of dissolved iron not seen in the initial samples. Apparently, oxidation of sulfide in the initial water samples gave a false impression of the composition of the raw water source. Preoxidation of the feedwater corrected this problem. (See also W87-09431) (Cassar-PTT)
W87-09435

GEOMETRIC PARAMETERS AND EFFICIENCY OF DIFFUSED AIR SYSTEMS,
Georgia Inst. of Tech., Atlanta.
B. M. Khudenko, and E. Shpirt.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 89-102, 6 fig, 11 ref.

Descriptors: *Wastewater treatment, *Scale effect, *Design criteria, *Aeration, *Oxygen transfer, Energy, Mixing, Dimensional analysis, Mass transfer, Flow pattern, Engineering.

The influence of geometric parameters on the oxygen transfer efficiency and the longitudinial dispersion of liquid in aeration tanks equipped with diffused air systems has been evaluated based on dimensional analysis. Design relationships have been developed for a wide range of applications such as the geometric and dynamic parameters of aeration tanks and aeration systems. The equations can also be used to select optimal energy requirements for an aeration system and to determine the sizes and other parameters of equipment so that desired flow patterns (complete mix, partial mix, or plug flow) can be achieved. (See also W87-09431) (Cassar-PTT)
W87-09437

SIGNIFICANCE OF OXYGEN TRANSFER VARIABLES IN THE SIZING OF DOME DIFFUSER AERATION EQUIPMENT,
Gray Engineering Group, Inc., Andover, ME.
R. G. Gilbert, and R. C. Sullivan.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 103-116, 10 fig, 5 ref.

Descriptors: *Wastewater treatment, *Aeration, *Scale effect, *Design criteria, *Oxygen transfer, Dome diffuser, Dissolved oxygen, Water depth, Tanks.

This paper contains a description of test results for an equipment performance development program undertaken to determine the relationship between oxygen transfer rate and the variables of airflow rate, water depth, and diffuser density, (diffusers per square foot of floor area) for a complete floor coverage fine bubble dome diffuser aeration system. These data form the basis for design parameters and scale-up considerations in the sizing of full-scale aeration systems of this type. The significant scale-up factors are identified and developed for proper sizing of the aeration equipment by the design engineer. All testing was accomplished in a 38.5-ft diameter full-scale aeration tank at 15 and 20-ft side water depths. Airflow rates were varied from 0.5 SCFM to 2.0 SCFM per dome. Diffuser density ranged from 2.2 sq ft to 5.4 sq ft per dome. The clean water non-steady state reaeration testing method was used to determine oxygen transfer rate. The development program results show the relationship between oxygen transfer rate and (a) water depth, (b) air flow rate

per dome, and (c) dome density. The relationship between water depth and dissolved oxygen equilibrium saturation concentration is also presented. Correlations and trends are shown graphically for ease of understanding. The results of this testing program are presented in the form of scale-up parameters for sizing aeration systems. Scale-up considerations and rules of thumb are discussed in a manner which will aid the design engineer in the proper sizing of aeration systems of this type. (See also W87-09431) (Author's abstract)
W87-09438

OPTIMIZATION OF MECHANICAL AERATORS IN A HYDRAULIC TWO-PHASE FLOW MODEL AND THE SCALE-UP OF THE RESULTS FOR THE PROTOTYPE,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydromechanik.
F. Nestmann.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 117-131, 15 fig, 8 ref.

Descriptors: *Wastewater treatment, *Scale effect, *Design criteria, *Pilot plants, *Oxygen transfer, *Aeration, Engineering, Mass transfer, Energy, Cone aerator, Bubbles.

Mechanical aerators with vertical shafts are investigated with respect to their hydrodynamic efficiency for wastewater systems. The main objective is to minimize energy consumption during the oxygenation process. A model system (models of different scale) was set up to investigate the most important fluid-mechanical and operational provisions to produce an effective oxygenation input rate in several realistic model scales. On the basis of theoretical considerations about mass transfer mechanisms a new mechanical cone aerator device is presented producing medium to fine bubble aeration. (See also W87-09431) (Author's abstract)
W87-09439

SCALING-UP STUDIES ON WASTEWATER SEDIMENTATION,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
G. W. Heinke.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 149-167, 11 fig, 3 tab, 20 ref.

Descriptors: *Wastewater treatment, *Design criteria, *Settling tanks, *Scale effect, *Sedimentation, Primary wastewater treatment, Clarifiers, Tanks, Ferric chloride, Suspended solids.

Column settling tests are an inexpensive and useful method of gathering information for design of settling tanks for primary wastewater treatment. It is necessary to have samples of the waste to be treated, particularly in industrial applications. Settling tests in existing tanks, using tracers, and hydraulic models can also provide data which may be helpful in design. Tentative design guidelines are proposed for primary horizontal-flow clarifiers treating domestic wastewater; design flow rate--maximum daily flow, normally 1.5 to 2 times average daily flow; mean detention time--30 min with chemical addition and 45 min without chemical addition, minimum detention time--10 min with chemical addition and 20 min without chemical addition; overflow rate--less than 2400 gal/day/sp ft; suspended solids removal efficiency for normal strength (100-200 mg per liter)--70%-85% with chemical addition and 40%-50% without chemical addition; and local velocity--below 15 mm per sec for 50% removal of suspended solids. (See also W87-09431) (Cassar-PTT)
W87-09441

DEVELOPMENT OF A NEW TYPE OF FLUIDIZED BED REACTOR,
Georgia Inst. of Tech., Atlanta.
R. M. Palazzola, and B. M. Khudenko.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 199-216, 10 fig, 5 tab, 18 ref.

Descriptors: *Wastewater treatment, *Water treatment, *Fluidized beds, *Scale effect, *Design criteria, *Channeling, *Baffles, *Filtration, Boiling.

A laboratory-scale experimental study has been conducted in order to develop a means for the control of channeling and boiling of fluidized beds. A fixed packing submerged in a fluidized bed has been suggested. The packing consists of several rows of horizontal grids comprised of inclined baffles, those baffles forming the contracting and expanding cells in the direction of the flow. Pressure and concentration gradients induced by this packing suppress the hydrodynamic disturbances in the bed which can be a potential cause of boiling. Other effects associated with the packing can be beneficially utilized in a number of applications. Further development of the packing requires large-scale testing of specific treatment process. (See also W87-09431) (Author's abstract)
W87-09444

MODELING FOR PROCESS SCALE-UP OF ADSORPTION AND ION EXCHANGE SYSTEMS,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
W. J. Weber, and J. O. Thaler.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 233-257, 13 fig, 20 ref, append.

Descriptors: *Wastewater treatment, *Water treatment, *Ion exchange, *Adsorption, *Activated carbon, *Scale effect, *Design criteria, *Pilot plants, Mass transfer, Flow velocity, Model studies, Michigan Adsorption Design and Applications Model, Films.

Factors which affect the performance of adsorption and ion exchange systems include influent character and concentration, type and physical form of the adsorbent or exchange resin, the nature of predominant equilibrium and rate-limiting mass transfer processes, the depth of the adsorber, and the velocity of flow. A substantial part of the effort associated with the design of such systems is involved in predicting the operational dynamics of the process for different combinations of these factors. This generally requires extensive pilot studies to verify laboratory feasibility data and facilitate scale-up and design. The duration and costs for such pilot studies can be minimized by mathematical models which can predict performance given certain basic information about the system. This paper reviews one such model, the Michigan Adsorption Design and Applications Model (MADAM), and discusses how the model can be utilized as the basis for scale-up of laboratory data to pilot plant systems, and, once verified at that level, for design and operation of full-scale systems. (See also W87-09431) (Author's abstract)
W87-09446

SCALE-UP OF A RADIUM-226 REMOVAL PROCESS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
P. M. Huck, and D. W. Averill.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 281-304, 6 fig, 11 tab, 9 ref.

Descriptors: *Wastewater treatment, *Scale effect, *Design criteria, *Pilot plants, *Industrial wastewater, *Mine wastes, *Radioisotopes, Uranium, Radium, Barium, Filtration, Clarification, Flocculation, Chemical precipitation.

A process for removal of radium-226 from uranium mining effluents was scaled up from laboratory batch tests through continuous flow bench scale and pilot scale to full scale. The process consisted of precipitation of radium with barium chloride followed by coagulation and flocculation to enhance the settling rate of the barium-radium sulfate coprecipitate, and sedimentation in a conventional clarifier. The scale-up study featured geometric similarity between laboratory and pilot plant equipment, the use of factorial designs and response surface methodology for efficient batch test optimization, the use of reaction kinetics to design the continuous flow bench scale process from batch results, and the use of power per unit volume concepts in scaling up to the pilot plant. Sensitivity testing at the pilot plant level showed that the scale-up was valid. However, several modifications were made, including replacement of flocculation and sedimentation by granular media filtration. (See also W87-09431) (Cassar-PTT)
W87-09448

RELATIONSHIP BETWEEN BENCH SCALE AND PROTOTYPE ACTIVATED SLUDGE SYSTEMS,
California Univ., Berkeley. Dept. of Civil Engineering.
D. Jenkins, D. S. Parker, A. M. VanNiekerk, Y. J. Shao, and S. E. Lee.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 307-322, 11 fig, 21 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Pilot plants, *Design criteria, *Scale effect, Aeration, Storage, Biological wastewater treatment, Dissolved oxygen, Clarification, Settling velocity.

Bench-scale activated sludge units can be used to simulate prototype activated sludge performance from the standpoint of organic matter removal rates, oxygen uptake rates, activated sludge settleability and secondary effluent quality only if certain experimental conditions are met. These include details of aeration basin and clarifier design, control of dissolved oxygen, nature of return sludge and waste inlet conditions, control of mixing intensity, duplication of aeration basin compartmentalization and waste feeding pattern. Auxiliary tests are required to predict effluent suspended solids levels attainable in practice. Many of the problems of poorly settling activated sludge in prototype systems can be traced to the design of prototype units on the basis of bench-scale units that did not consider these factors. Thus batch-fed bench-scale units usually produce better settling activated sludge than prototype continuous flow, completely-mixed units; and bench-scale laboratory units with very high dissolved oxygen concentrations caused by using air for mixing do not suffer from the poor settling brought on by low dissolved oxygen in prototype aeration basins. Lastly, the limitations inherent even in properly conducted bench-scale tests must be recognized. Variations in waste characteristics usually are not accounted for and turbulence may not be closely simulated by bench-scale tests. (See also W87-09431) (Author's abstract)
W87-09449

ROLE OF KINETIC MODELS FOR THE SCALE-UP OF BIOLOGICAL PROCESSES,
Technische Univ., Vienna (Austria).
W. Emde, and H. Kroiss.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 323-342, 23 fig, 6 tab, 1 app, 4 ref, append.

Descriptors: *Wastewater treatment, *Scale effect, *Industrial wastewater, *Design criteria, *Activated sludge process, *Kinetics, *Pilot plants, Model studies, Biological wastewater treatment, Chemical wastewater, Organic loading, Sugar, Steel industry, Sludge treatment, Vienna, Austria.

Kinetic models are developed for a general case of scaling up biological wastewater treatment processes. However, they can only be applied to specific cases if all necessary parameters are known. These parameters cannot be obtained from wastewater analysis or runs with sludge from another treatment plant. Design criteria must be developed from a pilot plant operated at loading conditions similar to the desired full-scale plant. Several examples are described: treatment of a chemical wastewater containing a small amount of dimethyl formamide, influence of shock load on sugar factory waste treatment, treatment of mixed industrial wastes (steel mill coking, chemical works, and beet sugar factory) at a regional facility, and treatment of domestic wastewater from

Vienna, Austria. (See also W87-09431) (Cassar-PTT)
W87-09450

SCALE-UP OF ACTIVATED SLUDGE AND TRICKLING FILTER PROCESSES,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
W. W. Eckenfelder, and T. P. Quirk.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 343-373, 29 fig, 5 tab, 13 ref.

Descriptors: *Wastewater treatment, *Pilot plants, *Design criteria, *Scale effect, *Activated sludge process, *Trickling filters, *Industrial wastewater, *Kinetics, Biological wastewater treatment, Organic compounds, Organic loading.

Scale-up for activated sludge processes treating industrial wastewaters considering effluent and sludge quality control is presented. Techniques for consideration of effluent suspended solids and organics stripping are discussed. Reaction models for trickling filtration are reviewed including: zero and first order, retardant and concentration dependent mechanisms and empirical formulations. Model equations are transformed into linear expressions which allow graphical determination of rate constants. Scale-up techniques are applied using studies of a number of municipal and industrial effluents. Scale-up calculations are presented utilizing laboratory data to determine full-scale performance for various packing media. (See also W87-09431) (Author's abstract)
W87-09451

EFFICIENCY AND PROCESS: STABILITY OF SINGLE STAGE AND MULTI-STAGE WASTEWATER TREATMENT PLANTS,
Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Wasserbau.
B. Bohnke, R. Damiecki, and M. Bettac.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 375-396, 25 fig, 4 tab, 8 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Trickling filters, Biological wastewater treatment, Efficiency, Statistical analysis, Multi-stage activated sludge process.

Efficiency and process stability were examined in 119 activated sludge plants and 30 trickling filter plants in the Netherlands and the Federal Republic of Germany. From the data a statistical method was developed to estimate the reliability of treatment processes. In general, the single stage systems were reliable only under low loading rates. Most single-stage systems can be improved by upgrading them to multi-stage systems, which have the following advantages: buffering capacity for variable influent concentrations, protecting following stages from harmful substances in the influent, separating purification steps such as carbon oxidation and nitrification, and using polishing lagoons. Several combinations of processes are possible. Trickling filter followed by activated sludge process produces a higher quality effluent than activated sludge process followed by trickling filter. Good BOD removal is also achieved with a two-stage activated sludge process, called the A-B system, with high-rate loading in the first stage and low-rate loading in the second stage. (Cassar-PTT)
W87-09452

SCALE-UP OF BIOLOGICAL WASTEWATER TREATMENT PROCESSES: PRACTICAL EXPERIENCES IN THE U.K.,
Water Research Centre, Stevenage (England).
P. F. Cooper, and A. G. Boon.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 397-417, 10 fig, 6 tab, 34 ref.

Descriptors: *Wastewater treatment, *Water treatment, *Scale effect, *Design criteria, *Activated sludge process, Biological wastewater treatment, Denitrification, Nitrates, Fluidized beds, Captivated sludge process, CAPTOR particles.

Several practical experiences from the United Kingdom are used to illustrate scale-up of advanced wastewater treatment processes from small-scale to full-scale. Scale-up is successful if the same hydrodynamic conditions are used in both systems. Biological kinetics are not affected by scale. Examples are partial denitrification in the activated sludge process at Rye Mead treatment works, denitrification of sewage effluent using an expanded bed biological reactor at East Hyde treatment works, upgrading an overloaded activated sludge plant using reticulated plastic foam (CAPTOR) particles, and biological fluidized bed treatment of sewage and potable water. (See also W87-09431) (Cassar-PTT)
W87-09453

DEVELOPMENT OF A COMPETITIVE TWO-STAGE BIOLOGICAL TREATMENT SYSTEM: RESULTS OF PILOT PLANTS AND FULL SCALE PLANTS,
Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Wasserbau.
B. Bohnke.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 419-431, 12 fig, 1 tab, 10 ref.

Descriptors: *Wastewater treatment, *Pilot plants, *Design criteria, *Scale effect, *Activated sludge process, Adsorption, Biological wastewater treatment, Efficiency, Multistage activated sludge process, Energy.

A two-stage biological wastewater treatment system, the A-B system, was developed in pilot plants and scaled up to a full-scale plant. Consisting of adsorption and activated sludge process, the system showed many advantages compared with a single-stage activated sludge process: (1) better treatment efficiency for the same sludge load in the B-stage, (2) improvement in sludge quality, (3) better process stability for the same treatment efficiency, (4) combination of the aerated grit chamber with A-stage, (5) the same maintenance requirements as a single-stage process, (6) savings in energy costs because considerable organic matter is adsorbed rather than biodegraded, (7) increase sludge production and gas production, (8) increased degradation of the more sparingly degradable organic matter, and (9) decreased system volume. The stability and efficiency are attributed to the strict separation of the two stages and to the very high sludge load of the A-stage. (Author's abstract)
W87-09454

SCALE-UP EXPERIENCE WITH THE WATERLOO SCP PROCESS IN INDUSTRIAL BIOMASS WASTE TREATMENT,
Waterloo Univ. (Ontario). Centre for Process Development.
M. Moo-Young, and D. Watkins.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 433-440, 5 fig, 4 tab, 5 ref.

Descriptors: *Wastewater treatment, *Design criteria, *Pilot plants, *Scale effect, *Cellulose, *Fermentation, *Industrial wastewater, Biological wastewater treatment.

The Waterloo (Ontario) SCP Bioconversion Process is based on novel fermentation technology whereby edible proteinaceous foodstuff containing 30-40% microbial protein is made by direct solid-substrate conversion of cellulosic materials. An overview of the design scale-up study of this process is presented. The strategy of organizational and techno-economic evaluations from laboratory fermentors to a 1,000-liter pilot unit and eventually to a 10,000-liter semi-commercial prototype with integrated ancillary equipment, having a potential capacity of 2 tonnes/day dry product is described. Factors affecting the technology transfer route from university research prototype testing to commercial implementation are discussed. Aspects of feedstock pretreatment and supplementation, culture conditions, fermentor design and operation, and product recovery are noted. (See also W87-09431) (Author's abstract)
W87-09455

SWINE LAGOON EFFLUENT APPLIED TO COASTAL BERMUDAGRASS,
North Carolina State Univ. at Raleigh. School of Agriculture and Life Sciences.
P. W. Westerman, J. C. Burns, L. D. King, M. R. Overcash, and R. O. Evans.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-152264, A10 in paper copy, A01 in microfiche. EPA-600/2-83-004, January 1983. 207 p, 28 fig, 59 tab, 84 ref, 6 append.

Descriptors: *Wastewater treatment, *Agricultural wastes, *Lagoons, *Land application, Bermudagrass, Waste disposal, Wastewater disposal, Land disposal, Hogs, Irrigation, Wastewater irrigation, Nitrates, Wastewater lagoons.

The utilization potential and the environmental effects of applying swine lagoon effluent to Coastal bermudagrass were evaluated for six years. Lagoon effluent was applied to 9m x 9m plots by weekly sprinkler irrigation during the growing season. Forage yield and quality, soil nutrient levels and water quality and quantity of runoff and subsurface lateral flow were evaluated. An intake trial with ewes was also conducted to determine animal acceptance of hay from lagoon-irrigated treatments. The results indicated that swine lagoon effluent can be an excellent source of nutrients for Coastal bermudagrass but water quality considerations, nitrate levels in forage, and long-term soil effects must be evaluated when determining acceptable maximum application rates, which is important when land area for application is limiting. (Author's abstract)
W87-09472

TOXICITY OF BALLAST-WATER TREATMENT EFFLUENT TO MARINE ORGANISMS AT PORT VALDEZ, ALASKA,
National Marine Fisheries Service, Auke Bay, AK. Auke Bay Lab.
For primary bibliographic entry see Field 5C.
W87-09514

EFFECTIVENESS OF OFFSHORE PRODUCED WATER TREATMENT,
Rockwell International, Newbury Park, CA. Environmental Monitoring and Services Center.
I. Lysyj, G. Perkins, J. S Farlow, and W. Lamoreaux.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 63-67, 4 tab, 2 ref.

Descriptors: *Oil pollution control, *Hydrocarbons, *Benzenes, *Toluene, *Xylenes, *Effluents, Performance evaluation, Chemical treatment, Oil pollution, Oily water, Cook Inlet, Alaska.

A study was made of the effectiveness of treatment methods for produced water from three offshore oil-extraction operations in Cook Inlet, Alaska. The overall effectiveness of individual process units was determined. The process streams and final effluents were analyzed for suspended organic matter (the oil), dissolved nonvolatile organic matter was made for each unit process and the reduction rates for each of the principal organic fractions present were determined. It was found that the current treatment technology was generally effective in reducing the oil content (suspended solids) of produced water. Over 90% reduction was achieved in the three cases studied, and the oil content in the treated effluent ranged between 5 and 36 milligram of carbon per liter (mg/l C). The average oil concentration in the treated effluents was 18 mg/l C. The treatment was less effective in reducing aromatic (volatile) hydrocarbon content in produced water. Average reduction was in the order of 30- to 50%. Benzene, toulene, and xylenes/ethylbenze (BTX) were found at all stages of the processes and in all finakl effluents. The average BTX concentration in treated effluents discharged to Cook Inlet was 9 mg/l. High levels of dissolved nonvolatile organic matter (ranging from 140 to 400 mg/l C) were found in all treated

effluent. Generally, the concentration of this fraction appeared to increase, rather than decrease, as a result of treatment. It is believed that this increase might be due to the addition of chemicals during the treatment and oxidation of petroleum matter leading to formation of water-soluble oxygenated organic compounds. Because of a very high concentration of dissolved organic matter in all treated effluent, additional detailed studies of this fraction are indicated. The highest-quality effluent was produced by multistage onshore treatment processes. The lowest quality effluent was generated by single stage on-platform treatment. (Author's abstract)
W87-09515

DEVELOPMENT OF A FLARING BURNER OIL DISPOSAL SYSTEM,
Seaward International, Inc., Falls Church, VA.
R. L. Beach, and K. R. Goldman.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 623-627, 7 fig, 1 tab, 2 ref.

Descriptors: *Oil spills, *Cleanup operations, *Incineration, Oil recovery, Oil.

A flaring burner for disposal of oil recovered from spill cleanup operations has been built and tested, and is being incorporated into a prototype Flaring Burner Disposal System for the U.S. Coast Guard. This system will meet Coast Guard requirements for air transportability, rapid deployment, and safe operation in remote arctic or offshore locations. Tests demonstrated that the burner was capable of the following: (1) Smokeless burning of the light oil at a design rate of 180 gallons per minute (gpm), with water spray addition; (2) Burning of 200-centistoke (CS) oils with acceptable smoke and low droplet fallout at rates up to 90 gpm; (3) Burning of 1600-cs oil with smoke and droplet fallout levels that may be acceptable under certain circumstances. This viscosity was in excess of the Coast Guard design objectives for viscosity level; (4) Smokeless burning of low-viscosity water-in-oil emulsions; and (5) Nearly smokeless burning of light oils at reduced rates without water spray addition (a consideration for arctic usage). (See also W87-09507) (Author's abstract)
W87-09560

5E. Ultimate Disposal Of Wastes

ATTENUATION OF CD AND PB SOLUBILITY IN MUNICIPAL WASTE INCINERATOR ASH,
Tennessee Valley Authority, Muscle Shoals, AL. Office of Agricultural and Chemical Development.
D. Behel, P. M. Giordano, and D. R. Stephenson.
Communications in Soil Science and Plant Analysis CSOSA2, Vol. 17, No. 4, p 385-392, 1986. 2 tab, 3 ref.

Descriptors: *Water pollution control, *Waste treatment, *Incinerator ash, *Cadmium, *Lead, *Municipal wastes, *Solubility, *Waste disposal, *Soil amendments, Calcium oxide, Lime, Phosphates.

Landfilling of ash from waste-to-energy conversion plants poses a potential problem because some ashes contain excessive concentrations of Cd and Pb according to the Extraction Procedure test (EP toxicity test) developed by the Environmental Protection Agency (EPA). Current EPA limits to delineate hazardous materials are 1.0 and 5.0 microgram/mL of Cd and Pb, respectively, in the 0.5 M acetic acid extract. Since incinerator residues from several facilities have been reported to exceed these levels, a study was initiated whereby ash was combined with different amendments in an attempt to reduce Cd and Pb solubility below EPA limits and to render the ash acceptable for landfilling. Amendments most effective in reducing Pb solubility and extractability by the EP test were: CaO; commercial calcitic lime--CaCO3; limestone scrubber sludge (LSS) from a coal-fired steam plant; fluidized bed waste (FBW) from a coal-fired steam plant; acidic NH4H2PO4 and basic K2HPO4; and elemental S. Cadmium solubility was reduced only by CaO and the phosphate sources. (Author's abstract)
W87-08776

MANAGING POWERPLANT COMBUSTION WASTES,
S. D. Strauss.
Power POWEAD, Vol. 131, No. 1, p 17-24, January 1987. 10 fig, 1 tab, 13 ref.

Descriptors: *Coal combustion wastes, *Waste disposal, *Powerplants, *Coal, *Path of pollutants, Water pollution sources, Fly ash, Bottom ash, Land disposal, Landfills, Sludge, Sludge disposal, Utilities, Economic aspects, Groundwater pollution, Monitoring wells, Monitoring.

Coal combustion wastes are not yet considered hazardous, but the utility industry is seeking solutions to the problem of the fly ash, bottom ash and sludge disposal designed for long-term economic optimization. Disposal practices available for the three types of combustion wastes were discussed and compared. Fly ash is now transported and stored dry at most stations and the necessary conditions and precautions for the dry ash landfills to prevent groundwater contamination were summarized. Disposal of wet bottom ash and fly ash taken as a slurry from powerplants was also discussed. Sludge-handling options were outlined. The need for monitoring systems designed to detect migration of any hazardous contaminant before it is carried a significant distance from its source is recognized by the utility industry; the use of monitoring wells and monitoring strategy were detailed. (Wood-PTT)
W87-08803

GEOLOGIC ISOLATION OF HIGH-LEVEL RADIOACTIVE WASTE: PUTTING IT AWAY FOREVER,
S. Smith.
Water Well Journal WWJOA9, Vol. 41, No. 4, p 31-39, April 1987. 7 fig.

Descriptors: *Radioactive waste disposal, *Waste disposal, *Underground waste disposal, *Groundwater pollution, *Groundwater, *Site selection, Water pollution, Radioactive wastes, Hanford Reservation, Washington, Yucca Mountain, Utah, Deaf Smith County, Texas, Geohydrology, Geology, Sites.

The goal of the U.S. Department of Energy's Civilian Radioactive Waste Management (CRWM) Program is to permanently store or dispose of an estimated 70,000 metric tons of high-level nuclear waste from civilian and defense sources and spent fuel from commercial nuclear reactors. The CRWM Program is looking for ways to handle, store, and transport the wastes safely to the underground repository. The groundwater aspects of the disposal site selection search were detailed. The three likely sites chosen are: (1) Hanford Reservation, Washington; (2) Yucca Mountain, Utah; and (3) Deaf Smith County Site, Texas. Hydrogeological studies, site characterizations, environmental assessments, and associated problems of the three locations were summarized. The final decision process is expected to begin next year. (Wood-PTT)
W87-08805

OMAHA RECYCLES SLUDGE IN AGRICULTURAL PROGRAM,
D. Slattery.
Public Works PUWOAH, Vol. 118, No. 3, p 74-76, March 1987. 1 tab.

Descriptors: *Sludge utilization, *Sludge disposal, *Agriculture, *Recycling, *Waste recovery, *Omaha, Nebraska, Sludge, Primary sludge, Secondary sludge, Nutrients, Soil management, Fertilizers, Waste disposal.

Farmers are beginning to look at sludge as a nutrient source for crop production as well as humus for eroded soils. The Missouri River Wastewater Treatment Plant serves 156,000 people and numerous industries in Omaha, Nebraska. The plant generated 50,000 cu yd of mixed primary and secondary anaerobically digested sludge in 1986 and is expecting to increase the quantity when full secondary treatment is initiated in 1988. Currently, the public works department is cooperating with 27 farmers located within an average hauling distance of 25 miles who are willing to take the risks associated with a new program in order to reduce their overhead costs and to revitalize their soils. Public education strategies were summarized. The environmental monitoring program and sludge transport methods were detailed. (Wood-PTT)
W87-08808

STOCHASTIC MODELLING OF A CONTAMINATED AQUIFER: THE UNCONDITIONAL APPROACH,
Technical Univ. of Denmark, Lyngby.
For primary bibliographic entry see Field 5B.
W87-08820

EFFECT OF FERTILIZATION WITH MUNICIPAL SLUDGE ON THE GLUTATHIONE, POLYAMINE, AND CADMIUM CONTENT OF COLE CROPS AND ASSOCIATED LOOPERS (TRICHOPLUSIA NI),
New York State Coll. of Agriculture and Life Sciences, Ithaca. Boyce Thompson Institute for Plant Research.
For primary bibliographic entry see Field 5C.
W87-08835

EFFECTS OF DISTILLERY WASTE ON THE PERFORMANCE OF CICER ARIETINUM L.,
Gorakhpur Univ. (India). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W87-08873

GROWTH OF MIXED MICROBIAL POPULATIONS IN GROUND WATER CONTAINING HIGHLY CHLORINATED ORGANIC WASTES,
Louisiana State Univ. Medical Center, New Orleans. Dept. of Microbiology, Immunology, and Parasitology.
For primary bibliographic entry see Field 5B.
W87-08878

DYNAMICS OF NITROGEN AND CARBON IN SOIL DURING PAPERMILL SLUDGE DECOMPOSITION,
Maine Univ. at Orono. Dept. of Plant and Soil Sciences.
L. M. Zibilske.
Soil Science SOSCAK, Vol. 143, No. 1, p 26-33, January 1987. 5 fig, 4 tab, 20 ref.

Descriptors: *Water pollution effects, *Nitrogen, *Carbon, *Mineralization, *Soil amendments, *Pulp and paper industry, *Sludge disposal, *Biotransformation, *Decomposition, Sludge, Dynamics, Temperature, Incubation, Statistical analysis, Regression analysis, Organic matter, Conservation, Nutrients, Respiration, Nitrification, Nitrogen cycle, Carbon cycle.

A study was designed to determine the effects of a papermill sludge on the dynamics of carbon mineralization (respiration) and nitrogen transformations (immobilization and mineralization) in soil incubated under laboratory conditions. A fertile agricultural soil was amended with primary papermill sludge at rates from 0 to 267 g/kg soil. Application of N-deficient papermill sludge caused significant reductions in extractable soil N. After a time, enough carbon was apparently mineralized from some lower rates during the incubation to allow the onset of N mineralization. The degree to which soil-extractable N levels recovered to original levels after the immobilization period was inversely related to sludge application rate at both incubation temperatures. Data indicate that papermill sludge decomposition may create an N deficiency in soil ranging from about 9 mg/kg to more than 14 mg/kg soil/g sludge after 250 d. Low sludge application rates displayed earlier net N mineralization and may be useful in reducing winter leaching of soil N, possibly improving soil organic matter over time. (Author's abstract)
W87-08891

EFFECTS OF PH AND SOIL TYPE ON CONCENTRATIONS OF ZINC, COPPER AND NICKEL EXTRACTED BY CALCIUM CHLORIDE FROM SEWAGE SLUDGE-TREATED SOILS,
Rothamsted Experimental Station, Harpenden (England).
For primary bibliographic entry see Field 5B.
W87-08911

TRACE AND NUTRIENT ELEMENT TRANSFER FROM SEWAGE SLUDGE-AMENDED SOIL TO CROPS: A STUDY ON BRASSICA OLERACEA,
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
For primary bibliographic entry see Field 5B.
W87-08917

SWINE MANURE AND LAGOON EFFLUENT APPLIED TO A TEMPERATE FORAGE MIXTURE: I. PERSISTENCE, YIELD, QUALITY, AND ELEMENTAL REMOVAL,
Agricultural Research Service, Raleigh, NC. Dept. of Crop Science and Animal Science.
For primary bibliographic entry see Field 5C.
W87-08919

SWINE MANURE AND LAGOON EFFLUENT APPLIED TO A TEMPERATE FORAGE MIXTURE: II. RAINFALL RUNOFF AND SOIL CHEMICAL PROPERTIES,
Agricultural Research Service, Raleigh, NC. Dept. of Agricultural and Biological Engineering.
For primary bibliographic entry see Field 5C.
W87-08920

RESIDUAL EFFECTS OF SEWAGE SLUDGE ON SOYBEAN: I. ACCUMULATION OF HEAVY METALS,
Maryland Univ., College Park. Dept. of Agronomy.
For primary bibliographic entry see Field 5C.
W87-08921

RESIDUAL EFFECTS OF SEWAGE SLUDGE ON SOYBEAN: II. ACCUMULATION OF SOIL AND SYMBIOTICALLY FIXED NITROGEN,
Maryland Univ., College Park. Dept. of Agronomy.
For primary bibliographic entry see Field 5C.
W87-08922

AMMONIUM BICARBONATE-DTPA AND DTPA EXTRACTIONS OF SLUDGE-AMENDED SOILS,
Colorado State Univ., Fort Collins. Dept. of Agronomy.
For primary bibliographic entry see Field 5A.
W87-08923

SOYBEAN GROWTH AND BORON DISTRIBUTION IN A SANDY SOIL AMENDED WITH SCRUBBER SLUDGE,
Minnesota Agricultural Experiment Station, St. Paul.
For primary bibliographic entry see Field 5C.
W87-08927

EFFECT OF SEWAGE SLUDGE ON SOIL STRUCTURAL STABILITY: MICROBIOLOGICAL ASPECTS,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
For primary bibliographic entry see Field 5C.
W87-08997

SLOPE GRADIENT EFFECT ON EROSION OF RESHAPED SPOIL,
North Dakota State Univ., Mandan. Land Reclamation Research Center.
For primary bibliographic entry see Field 2J.
W87-09000

DEVELOPMENT OF A SIMPLIFIED COLUMN TEST FOR EVALUATION OF THICKNESS OF CAPPING MATERIAL REQUIRED TO ISOLATE CONTAMINATED DREDGED MATERIAL,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5G.
W87-09091

LEACHING RADIOACTIVE AND NONRADIOACTIVE ELEMENTS FROM ACTUAL SAVANNAH RIVER PLANT NUCLEAR WASTE GLASS,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 5B.
W87-09112

DEVELOPMENT PROGRAMS IN THE UNITED STATES OF AMERICA FOR THE APPLICATION OF CEMENT-BASED GROUTS IN RADIOACTIVE WASTE MANAGEMENT,
Oak Ridge National Lab., TN.
L. R. Dole, and T. H. Row.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as DE84-014251. Price codes: A03 in paper copy, A01 in microfiche. DOE Report No. CONF-8406170--2, (1984). 27 p, 11 fig, 31 ref. DOE Contract No. DE-AC05-84OR21400.

Descriptors: *Radioactive waste disposal, *Radioactive wastes, *Cements, *Waste management, *Leaching, *Path of pollutants, Nuclear powerplants, Waste dumps, Solid waste disposal, Leachates, Hazardous materials, Economic aspects.

This paper briefly reviews seven cement-based waste form development programs at six of the U. S. Department of Energy (DOE) sites. These sites have developed a variety of processes that range from producing 25 mm (1 in) diameter pellets in a glove box to producing 240 m (800 ft) diameter grout sheets within the bedding planes of a deep shale formation. These successful applications of cement-based waste forms to the many radioactive waste streams from nuclear facilities bear witness to the flexibility and reliability of this class of materials. This paper also discusses the major issues regarding the application of cement-based waste forms to radioactive waste management problems. These issues are: leachability, radiation stability, thermal stability, phase complexity of the matrix, and effects of the waste stream composition. A cursory review of current research in each of these areas is given. This paper also discusses future trends in cement-based waste form development and applications. (Author absract-PTT)
W87-09113

ZINC, COPPER AND NICKEL CONCENTRATIONS IN SOIL EXTRACTS AND CROPS GROWN ON FOUR SOILS TREATED WITH METAL-LOADED SEWAGE SLUDGES,
Rothamsted Experimental Station, Harpenden, Herts, AL5 2JQ, Great Britain.
For primary bibliographic entry see Field 5B.
W87-09244

DESIGN AND USE OF PRESSURE SEWER SYSTEMS,
Thrasher Engineering, Rogers, AR.
For primary bibliographic entry see Field 5D.
W87-09309

SEPTIC TANK SYSTEM EFFECTS ON GROUND WATER QUALITY,
Oklahoma Univ., Norman. Environmental and Ground Water Inst.
For primary bibliographic entry see Field 5C.
W87-09310

ESTABLISHMENT OF BIOTIC COMMUNITIES WITHIN A NEWLY CONSTRUCTED ASH SETTLING BASIN AND ITS DRAINAGE SYSTEM,
Texas Univ. Health Science Center at Houston. School of Public Health.
R. K. Guthrie, D. S. Cherry, E. M. Davis, and H. E. Murray.
IN: Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms, A Symposium Sponsored by ASTM Committee D-19, Ft. Lauderdale, FL, 29-30 January 1979. ASTM STP 730, 1981. p 243-254, 4 fig, 5 tab, 9 ref.

Descriptors: *Biotic environment, *Waste disposal, *Water pollution effects, *Ash, *Environmental effects, *Ash, *Settling basins, *Savannah River, *Georgia, Drainage systems, Ecosystems, Seasonal variation, Water quality, Plankton, Invertebrates, Benthic environment, Aquatic environment.

A newly constructed coal-ash settling basin and its drainage system at the 400D area powerplant of the Savannah River Project, in Aiken, S.C., were studied from April 1977 to December 1978. The basin was filled in August 1977 by a flow of 7500 L/min that consisted of Savannah River water and coal ash. The effluent was released to an excavated canal approximately 300 m in length, which drained into an older stream (300 m long) and then into a 3-cu km swamp area that had received effluent from a previous ash settling basin. Between March and August 1977, the stream and swamp received only runoff from rainfall. During this time, when no basin effluent was released to the stream and swamp, the water quality characteristics were altered, and aquatic biota were reduced throughout the system. The water quality characteristics were tested in the new ash settling system approximately every two months between April 1977 and December 1978. During the period of study, there were no major changes in water quality characteristics within the new basin. Seasonal peaks occurred in the bacterial populations in warmer months, and the composition of these populations within the basin system was determine to be different from that in the Savannah River. Sparse planktonic populations within the basin increased in numbers and diversity as the basin stabilized. Data obtained indicate that an efficient settling basin for coal ash has provided a suitable habitat for varied aquatic biotic communities, although some characteristics of the effluent have affected the normal balance and stability of communities within this environment. Such findings are important in that the suitability of receiving water habitats to aquatic life should be little affected by the release of effluent from such a basin. (See also W87-09311) (Author's abstract)
W87-09323

BASIC DATA REPORT FOR DRILLING AND HYDROLOGIC TESTING OF DRILLHOLE DOE-2 AT THE WASTE ISOLATION PILOT PLANT (WIPP) SITE,
Sandia National Labs., Albuquerque, NM.
J. W Mercer, R. L. Beauheim, R. P. Snyder, and G. M. Fairer.
Sandia Report SAND86-0611, April 1987. 315 p, 28 fig, 5 tab, 39 ref, 6 append. DOE Contract No. DE-AC04-76DP00789.

Descriptors: *Waste disposal, *Disposal sites, *Hydrologic properties, *Hydrologic data collections, *Drilling, Salado Formation, Boreholes, Geohydrology, Halites, Anhydrites, Pumping tests.

Drillhole DOE-2 was drilled to investigate suitability of a structural depression marked by the downward displacement of stratigraphic markers in the Salado Formation approximately 2 miles north of the center of the WIPP site for nuclear waste disposal. This depression was named informally after the shallow borehole FC-92 in which the structure was described. The presence of the depression was confirmed by drilling. Contrary to several hypotheses, halite layers were thicker in the lower part of the Salado, not thinner as a result of any removal of halite. The upper Castile anhydrite in Drillhole DOE-2 is anomalously thick and is strongly deformed relative to the anhydrite in adjacent drillholes. In contrast, the halite was < 8-ft thick and significantly thinner than usually encountered. The lower Castile anhydrite appears to be normal. The depression within the correlated marker beds in the Salado Formation in Drillhole

DOE-2 is interpreted as a result of gravity-driven deformation of the underlying Castile Formation. Several stratigraphic units were hydrologically tested in Drillhole DOE-2. Testing of the unsaturated lower portion of the Dewey Lake Red Beds was unsuccessful because of exceptionally small rates of fluid intake. Drill-stem tests were conducted in five intervals in the Rustler Formation, over the Marker Bed 138-139 interval in the Salado Formation, and over three sandstone members of the Bell Canyon Formation. A pumping test was conducted in the Culebra Dolomite Member of the Rustler Formation. Pressure-pulse tests were conducted over the entire Salado Formation. Fluid samples were collected from the Culebra Dolomite Member and from the Hays Member of the Bell Canyon Formation. (Author's abstract)
W87-09333

INTERNAL HYDRAULICS OF DIFFUSERS WITH UNIFORM LATERAL MOMENTUM DISTRIBUTION,
Concordia Univ., 1455 De Maisonneuve, Montreal, Quebec, Canada H3G 1M8.
For primary bibliographic entry see Field 8B.
W87-09366

WASTEWATER-INDUCED SOIL CLOGGING DEVELOPMENT,
RSE Group, Ayres Association, Madison, WI 53704.
For primary bibliographic entry see Field 5C.
W87-09373

EVALUATING ASPHALT CAP EFFECTIVENESS AT SUPERFUND SITE,
Solid Wastes Disposal Program; National Solid Wastes Management Association, Washington, DC 20036.
E. W. Repa, J. G. Herrmann, E. F. Tokarski, and R. T. Eades.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 3, p 649-653, June 1987. 1 tab, 8 ref. EPA Contract 68-03-3113, Work assignment 39-5.

Descriptors: *Waste disposal, *Superfund sites, *Capping, *Hydraulic conductivity, *Asphalt caps, Performance evaluation, Design criteria, Groundwater pollution.

The Western Processing Co., Inc., Superfund site is ranked 48th out of the 786 sites on the 'National Priority List'. The site is located within the city limits of Kent, Washington, approximately 24 km south of Seattle and occupies about 5.3 ha. An asphalt cap was placed on approximately 1.6 ha of the site at the location of an old chemical reaction pond. After cap placement, the intrinsic permeability of selected asphalt concrete cores from the cap were measured using air, clean water, and contaminated site water as permeants. Test results were then used to calculate the hydraulic conductivities of the cores. A percentage of air voids analysis was also performed as a check on the intrinsic permeability test results. The recommendations are: (1) Asphalt content should vary from 6-9.5%; (2) mineral filler content should vary from 8-13%; (3) aggregate size should be matched to compacted depth to ensure proper compaction without bridging of the coarse aggregate; (4) pavement samples should be tested under both laboratory and field conditions; (5) the subgrade should be properly prepared in order to drain water under the pavement and provide a stable foundation; (6) joint edges should be sloped at a 1:1 ratio to ensure proper compaction; (7) a tack coat should be applied to joint edges when the mix is cold to ensure proper bonding; (8) the asphalt concrete should be compacted to 4% air voids; and (9) the pavement surface should be sealed with an asphalt sealer. (Alexander-PTT)
W87-09379

MULTIYEAR STUDY OF SLUDGE APPLICATION TO FARMLAND: PREVALENCE OF BACTERIAL ENTERIC PATHOGENS AND ANTIBODY STATUS OF FARM FAMILIES,
Dept. of Medical Microbiology, The Ohio State Univ., Columbus, OH 43210.
For primary bibliographic entry see Field 5C.
W87-09394

ENVIRONMENTAL ASPECTS OF ENERGY RELATED SOLID WASTE,
National Center for Analysis of Energy Systems, Upton, NY. Biomedical and Environmental Assessment Div.
M. A. Crowther, and S. C. Morris.
Available from the National Technical Information Service, Springfield, VA 22161, as DE-83 000769, A07 in paper copy, A01 in microfiche. BNL--51405. April 1981. 118 p, 4 fig, 23 tab, 59 ref. Contract No. DE-ACO2-76CH00016.

Descriptors: *Waste disposal, *Water pollution sources, *Mine wastes, *Literature reviews, Solid waste disposal, Shales, Oil shale, Energy conversion, Coal gasification, Electric power production, Trace metals, Organic compounds, Sludge, Fly ash, Spoil banks, Waste treatment.

A literature review of solid waste disposal in the energy industries includes regulatory impacts, waste characterization, waste disposal options, waste utilization, and environmental and health impacts. Coal combustion, gasification, liquefaction, and oil shale are considered. By 2000 an estimated 170 million tons of scrubber sludge and 125 million tons of ash will be produced annually by utilities, a 2- to 4-fold increase over that produced in 1975. Inadequate management of this waste could lead to mobilization of trace metals and other contaminants into groundwater and surface water. The highly variable nature of wastes and their disposal sites assures that treatment methods must be customized. Disposal methods include ponding in clay soil with impervious liners, chemical treatment and landfill, disposal in mines, and ocean disposal. Proper management must consider long-term monitoring, runoff prevention or control, structural strength, permeability, leachate potential, solid attenuation of leachate, liner life, and dewatering methods. Wastes from coal gasification and liquefaction are particularly variable in composition. Among the substances which require disposal are heavy metals from spent catalysts and organic sludges (may be incinerated). Oil shale processing results in large quantities of spent shale, which is a source of organic pollutants. Other possible problems with the spoil banks are mass movement affecting runoff and infiltration, runoff and leaching causing water pollution, surface destabilization leading to wind and water erosion, and bioaccumulation of hazardous substances in vegetation. (Cassar-PTT)
W87-09427

SCALE-UP OF SOLID BOWL CENTRIFUGES FOR SLUDGE DEWATERING,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
P. A. Vesilind.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 217-229, 8 fig, 2 tab, 2 ref.

Descriptors: *Sludge drying, *Dewatering, *Wastewater treatment, *Centrifugation, *Scale-up, *Design criteria, Bowl centrifuges.

The variables influencing centrifugal dewatering are classified into three types: (1) fixed machine variables (bowl diameter, bowl length, beach angle, beach length, scroll pitch, scroll leads, sludge feed point); (2) selected machine variables (bowl speed, pool depth, scroll speed, chemical feed point); and (3) process variables (slurry, feed rate, sludge type, chemical feed rate). With the exception of the rate of chemical conditioner addition, increases in solids recovery are accompanied by a decrease in cake solids concentration. The scale-up procedure for clarification and solids throughput are given. For successful scale-up both the liquid flow rate and the solids loading must be estimated. Activated sludge and calcium carbonate slurry are used in a sample scale-up. Mathematical equations are given to calculate the hydraulic capacity of a larger solid bowl centrifuge from data for a geometrically similar, smaller one using the same slurry and to estimate the solids handling capacity. (See also W87-09431) (Cassar-PTT)
W87-09445

DREDGED MATERIAL CONTAINMENT IN LONG ISLAND SOUND (WITH SPECIAL EMPHASIS ON EASTERN NEW YORK WATERS),
Tetra Tech, Inc., Melville, NY.
For primary bibliographic entry see Field 8A.
W87-09474

PROCEEDINGS: 1981 OIL SPILL CONFERENCE (PREVENTION, BEHAVIOR, CONTROL, CLEANUP).
American Petroleum Inst., Washington, DC.
For primary bibliographic entry see Field 5B.
W87-09507

EVALUATION OF OIL SPILL DISPERSANT TESTING REQUIREMENTS,
SRI International, Menlo Park, CA.
For primary bibliographic entry see Field 5G.
W87-09508

5F. Water Treatment and Quality Alteration

RECOVERY OF WATER FROM ATMOSPHERIC AIR IN ARID CLIMATES,
Corning Glass Works, NY. Research and Development Labs.
T. H. Elmer, and J. F. Hyde.
Separation Science and Technology SSTEDS, Vol. 21, No. 3, p 251-266, May 1986. 10 fig, 9 tab, 3 ref.

Descriptors: *Drinking water, *Arid climates, *Condensation, *Hydrated salts, *Solar energy, Adsorption, Humidity, Atmosphere.

The possibility of using hydrated salts supported on carrier beds for extracting water from cool night air and solar energy for recovering the moisture for use as drinking water is dealt with. Equipment for obtaining sorption data in the laboratory is described. The rate of water adsorption by salts from air is a linear function of relative humidity, the amount adsorbed depending on the partial pressure of water exerted by the hydrated salt or by the aqueous salt that results on exposure to the moist air. To assure maximum adsorption it is important to select salts whose saturated aqueous solution exhibits minimal aqueous tension. Hydrated salts supported on carriers, composed of as widely different materials as porous glass, sand, and fibrous board, all release water equally well on heating, despite their large differences in physical makeup. (Author's abstract)
W87-08601

REMOVAL OF ANTIMONY FROM AQUEOUS SYSTEMS,
Vanderbilt Univ., Nashville, TN. Dept. of Chemistry.
K. Gannon, and D. J. Wilson.
Separation Science and Technology SSTEDS, Vol. 21, No. 5, p 475-493, July 1986. 2 fig, 7 tab, 40 ref.

Descriptors: *Antimony, *Water treatment, *Aqueous solutions, *Coprecipitation, Colloids, Iron, Aluminum, Lime, Sulfides, Toxicity.

Antimony(III) is readily removed from aqueous systems by coprecipitation with ferric hydroxide and by adsorbing colloid flotation with ferric hydroxide and sodium dodecyl sulfate. Aluminum hydroxide is not effective in removing antimony. Precipitation with lime requires quite large quantities of lime in order to reduce residual Sb levels to desired levels. Precipitation of the sulfide in the presence of Fe(II) or Fe(III) may produce low residual concentrations, but runs the risk of exposure to highly toxic hydrogen sulfide. (Author's abstract)
W87-08604

SEPARATION OF MERCURY FROM AQUEOUS MERCURIC CHLORIDE SOLUTIONS BY ONION SKINS,
Osaka Prefecture Univ., Sakai (Japan). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W87-08606

BACTERIOLOGICAL QUALITY OF DRINKS FROM VENDING MACHINES,
University Hospital of Wales (Cardiff). Public Health Lab.
P. R. Hunter, and S. H. Burge.
Journal of Hygiene JOHYAY, Vol. 97, No. 3, p 497-500, December 1986. 3 tab, 5 ref.

Descriptors: *Potable water, *Vending machines, *Coliforms, *Water quality, *Bacteriology, *Drinking water, Public health.

A survey on the bacteriological quality of both drinking water and flavored drinks from coin operated vending machines is reported. Forty four percent of 25 drinking water samples examined contained coliforms and eighty four percent had viable counts of greater than 1000 organisms ml at 30 degrees C. Thirty one flavored drinks were examined; six percent contained coliforms and thirty nine percent had total counts greater than 1000 organisms ml. This is in conflict with the recent European Community directive on quality of all potable water, even after it has left the main supply. It is suggested that the D.H.S.S. code of practice on coin operated vending machines is not being followed. It is also suggested that drinking water should not be dispensed from such machines, and that hot drinks should be of a sufficiently high temperature, and cold drinks of a sufficiently low pH to kill any coliform organisms present. (Author's abstract)
W87-08704

IMPROVEMENT OF IRRIGATION WATER BY GYPSUM BEDS,
Haryana Agricultural Univ., Hisar (India). Dept. of Soils.
For primary bibliographic entry see Field 5G.
W87-08745

WATER USE AND HEALTH IN MUEDA, MOZAMBIQUE,
London School of Hygiene and Tropical Medicine (England). Dept. of Tropical Hygiene.
S. Cairncross, and J. L. Cliff.
Transactions of the Royal Society of Tropical Medicine and Hygiene TRSTAZ, Vol. 81, No. 1, p 51-54, 1987. 4 tab, 3 ref.

Descriptors: *Water supply, *Domestic water use, *Mueda, *Public health, *Bathing, Food habits, Diets, Mozambique, Trachoma.

A comparison of domestic water use in 2 villages in Mueda, Mozambique, indicated that a reduction in the length of the water collection journey from 5 h to 10 min was associated with an increase in average water consumption from 4.1 to 11.1 liters per person per day. Bathing and washing clothes accounted for 70% of the increased total. Bathing of children was a regular nightly event in the village with a water supply but almost unknown in the other. Water used for food preparation also increased, suggesting that scarcity of water may also influence diet. A major benefit of water supply is the saving of women's time and effort from water collection. In Mueda, it was an average of 1 3/4 h per day. More than half the time saved was spent on other household tasks, particularly grinding cereals, and on other productive work. Women spent much of the remainder with their children. A trachoma survey, organized as a training exercise for medical students, found a 19% prevalence of trachoma in the village with a water supply, while the prevalence was twice this figure in another village with no supply. (Author's abstract)
W87-08777

KNOWLEDGE ATTITUDES AND PRACTICES IN RELATION TO SCHISTOSOMIASIS IN A RURAL COMMUNITY,
Blair Research Lab., Causeway (Zimbabwe).
P. Taylor, S. K. Chandiwana, J. M. Govere, and F. Chombo.
Social Science Medicine SSMDEP, Vol. 24, No. 7, p 607-611, April 1987. 5 tab, 17 ref.

Descriptors: *Public health, *Rural areas, *Schistosomiasis, *Sanitation, *Water supply, Latrines, Surveys, Education.

A knowledge attitudes and practices survey of sanitation, water supplies and schistosomiasis was carried out in a rural schistosomiasis endemic area of Zimbabwe. Questionnaires were administered to 349 households. No latrines were present 61% of households and information on use, likes and dislikes was collected. Most drinking water was collected from sources presenting no risk of schistosomiasis whereas most washing activities were carried out at sites presenting such a risk. Schistosomiasis was thought to be a problem in the community by over 50% of households and 79% gave haematuria as a symptom of the disease. There was a correlation between the washing site and the reported presence of schistosomiasis in the family. (Author's abstract)
W87-08778

GIANT WATER TANK RISES IN AUSTIN,
J. J. Kosowatz.
Engineering News Record ENREAU, Vol. 218, No. 12, p 79,81, March 1987.

Descriptors: *Water tanks, *Water storage, *Reservoirs, *Costs, *Construction costs, Construction, Economic aspects, Reservoir construction, Construction methods, Construction materials, Austin, Texas, Storage reservoirs, Storage tanks.

The largest ground-level water storage reservoir is being built in Austin, Texas. The Martin Hill Reservoir has a storage capacity of 34 million gallons and its height and volume provide enough pressure for the distribution of 10 million gallons. The alternative designs that were considered were summarized along with the respective initial and long-term costs. Construction costs and procedures were mentioned. The tank is expected to be ready for operation by the end of May. (Wood-PTT)
W87-08801

COOPERATIVE SOLUTION FOR A WATER SYSTEM 'EMERGENCY',
E. Becker, and R. G. Neuner.
Public Works PUWOAH, Vol. 118, No. 3, p 66-67, March 1987.

Descriptors: *Water treatment facilities, *Water treatment, *Filtration, *Municipal water, New Jersey, Drinking water, Anthracite, Filters, Costs, Economic aspects.

In March 1986 residents of the Borough of Butler, New Jersey, found small pieces of anthracite in their drinking water. It was determined that the problem was due to filter media losses. Therefore, the horizontal filters which were out of service at the time were inspected and the shop drawings were reviewed. It was found that of the original 36 inches of graded anthracite, only 26 inches remained in one filter, 16 in a second, and only a few in the third. Strainers were missing, clogged, or greatly impaired. The field studies enabled the engineers to identify the circumstances which contributed to the failure of the filter underdrain system and allowed the media to enter the water system. Because of the emergency situation, the Borough was able to deal directly with a filter construction company thus saving more than two months in filter downtime and thousands of dollars in reconstruction costs. Details of the successful rehabilitation work were presented. (Wood-PTT)
W87-08807

PRESENCE OF LEGIONELLA IN LONDON'S WATER SUPPLIES,
Thames Water Authority, London (England).
J. S. Colbourne, and R. M. Trew.
Israel Journal of Medical Sciences IJMDAI, Vol. 22, No. 9, p 633-639, September 1986. 5 tab, 14 ref.

Descriptors: *Legionella, *London, *Water supply, *Domestic water, *Cooling water, *Public health, *Surveys, Bacteria, Pathogenic bacteria, Isolation, Water pollution sources, Monitoring, Rivers, Water conveyance, Sampling, Diseases, Human diseases, Epidemiology, Potable water, Microbiological studies.

A study was conducted to determine the frequency of Legionella in London's drinking water over a period of a year, from the treatment plant to the consumer's tap. Legionella has not been isolated from raw river water entering London's treatment works or from treated water entering the distribution network. Sixty-two monitoring taps in buildings located in 21 supply areas were sampled twice for Legionella; only 2 (2.4%) were positive during the autumn/winter of 1985/86. The strain found was L. pneumophila serotype 1, subgroup Olda, and numbers ranged from 100 to 10,000/l. Although the survey is incomplete, it is concluded that London's public water supplies are not a source of strains of Legionella associated with disease. (Doria-PTT)
W87-08901

BIOCIDAL CONTROL OF LEGIONELLAE,
Boots Company PLC, Nottingham (England).
R. Elsmore.
Israel Journal of Medical Sciences IJMDAI, Vol. 22, No. 9, p 647-654, September 1986. 5 fig, 3 tab, 29 ref.

Descriptors: *Biocides, *Legionella, *Cooling water, *Growth, *Water treatment, Pesticides, Field tests, Bacteria, Pathogenic bacteria, Diseases, Human diseases, Performance evaluation, Fungi, Monitoring, Isolation, Ecology, Microbiological studies.

The use of biocides is examined for controlling the growth of Legionella pneumophila in recirculating cooling water systems. The reasons for using biocides and their ideal properties are discussed. Comparative studies on the activity of several biocides against Legionella are reported, with more detailed laboratory and field studies on 2-bromo-2-nitropropane-1,3-diol (BNPD). Laboratory results show that all the commercially available water-treatment biocides tested inhibited the growth of Legionella at MIC values ranging from 6.25 ppm to 800 ppm. BNPD was effective both in the laboratory and cooling-tower studies. The activity of biocides against specific organisms implicated in supporting the growth of L. pneumophila is discussed. It is concluded that biocides selected for Legionella control should possess broad-spectrum activity. (Author's abstract)
W87-08904

EPIDEMIOLOGICAL EVIDENCE OF LEGIONELLOSIS TRANSMISSION THROUGH DOMESTIC HOT WATER SUPPLY SYSTEMS AND POSSIBILITIES OF CONTROL,
Alexis Carrel Faculty of Medicine, Lyon (France).
National Health Lab.
N. Bornstein, C. Vieilly, M. Nowicki, J. C. Paucod, and J. Fleurette.
Israel Journal of Medical Sciences IJMDAI, Vol. 22, No. 9, p 655-661, September 1986. 2 fig, 1 tab, 15 ref.

Descriptors: *Path of pollutants, *Epidemiology, *Legionella, *Domestic water, *Water conveyance, *Water treatment, *Human diseases, Diseases, Bacteria, Pathogenic bacteria, Hospitals, Contamination, Water pollution sources, Water pollution effects, Microbiological studies, Chlorination, Temperature effects, Decontamination, Chlorine, Temperature, Water temperature, Physical properties.

Evidence was sought for an epidemiological link between hot water supply systems and the occurrence of Legionnaire's disease in two settings for which diverging results were obtained when similar eradication protocols were applied. The two settings were an administrative building associated with a fatal case due to Legionella pneumophila SG 1, and a hospital with 11 cases due to L. anisa. Two decontamination methods were applied:

chlorination and a rise in hot water temperature. Time-limited control measures in the hospital were inadequate, resulting in only temporary eradication, followed by a rapid recolonization of legionellae and the appearance of new nosocomial cases. Decontamination of the administrative building was effective when a constant concentration of 5 ppm free chlorine was obtained at tap outlets and the water temperature was maintained at 55 C. (Author's abstract)
W87-08905

ASSOCIATION BETWEEN LEGIONELLA PNEUMOPHILA AND AMOEBAE IN WATER,
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
M. Henke, and K. M. Seidel.
Israel Journal of Medical Sciences IJMDAI, Vol. 22, No. 9, p 690-695, September 1986. 2 fig, 5 tab, 26 ref.

Descriptors: *Legionella, *Protozoa, *Groundwater, *Potable water, *Microbiological studies, *Ecology, *Epidemiology, Sampling, Filtration, Membrane filtration, Sample preparation, Agars, Culture media, Isolation, Temperature, Incubation, Drinking water, Culturing techniques, Growth, Bacteria, Pathogenic bacteria.

The presence of amebae and Legionella pneumophila was investigated in groundwater, drinking water supplies, and whirlpools in 5 German cities. Samples were concentrated by membrane filtration. L. pneumophila was detected on buffered charcoal yeast extract agar, and amebae by inverting filters on nonnutrient plates seeded with Eschirichia coli. Amebae were detected in 65% of samples found to be positive for L. pneumophila, and L. pneumophila and amebae were detected together in 38% of warm drinking water samples. Amebae were found in 88% of cold drinking water samples. The presence of L. pneumophila and amebae in whirlpool waters (42%) presents a risk for man. Amebae were found to support intracellular multiplication of L. pneumophila in Chang's medium and autoclaved tap water. Results confirmed that interaction between L. pneumophila and amebae could occur in nature, and that the latter could act as hosts for legionellae and support their growth. (Author's abstract)
W87-08906

INNOVATIVE STATE POLICIES FOR AIDING COMMUNITY WATER SUPPLIERS,
Transportation Research Board, Washington, DC.
N. P. Humphrey, and C. Walker.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 5, p 34-41, May 1987. 1 fig, 1 tab, 4 ref, 2 append.

Descriptors: *Water supply, *Policy initiatives, *Economic aspects, *Financing, *Credit, Drinking water.

State policy initiatives for assisting communities in managing, financing, and regulating water supplies are discussed. States can provide either direct assistance through grants or loans, or act as intermediaries to lend their stronger credit support to communities that otherwise would not have access to the national credit markets. The choice of the specific aid mechanism depends on the state's financial position and on its program objectives. Financial assistance alone, however, may be insufficient to resolve the more fundamental institutional problems that hamper provision of drinking water. Several states have tied financial aid programs to incentives for reforming local management practices. Others have initiated programs with the sole purpose of encouraging improved water resource management. Finally, if water supply problems are critical, states may regulate management practices and use of local water supplies. (Author's abstract)
W87-08951

REGULATORY DILEMMAS ENSNARE ARIZONA'S SMALL WATER COMPANIES,
H. A. Holub.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 5, p 42-47, May 1987.

Descriptors: *Development, *Water rates, *Water supply, *Regulations, *Legal aspects, *Arizona, Conservation, Public health.

The hundreds of small privately owned water companies in Arizona that have been spawned by development of rural subdivisions are faced with conflicting state conservation requirements and health regulations in addition to the state's public utility regulatory agency, which rules on rate cases. In many instances, developers are unwilling to subsidize the cost of maintaining and operating the water systems necessary for the sale of lots in the subdivision once all the lots are sold. Homeowners are faced with inadequate or unsafe water supplies and depreciated or unsalable properties. The size of the rate increases that would be necessary to rectify the inadequacies of these small systems is politically unpalatable, and noncompliance with health regulations caused by inadequate revenues incurs penalties. Reforms seem to be mandatory, and in the fall of 1986, a sweeping set of proposals worked out by an appointed committee was submitted to the state legislature. (Author's abstract)
W87-08952

WATER RESOURCES AUDIT FOR SMALL COMMUNITIES,
Texas Tech Univ., Lubbock. Water Resources Center.
K. M. Trauth, B. J. Claborn, and L. V. Urban.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 5, p 48-51, May 1987. 1 fig, 2 ref.

Descriptors: *Water supply, *Water resources audit, *Communities, *Management planning, Water conservation, Wastewater reuse, Water demand.

Small and intermediate-sized municipalities frequently lack the resources to carry out effective water management programs. A detailed, 'do-it-yourself' audit is now available to such communities to help them identify available water resources, isolate problem areas, set goals, and develop management strategies. Stressing water conservation and reuse, the audit has five goals: to identify the potential for conservation, to reduce volumetric demand, to reduce peak demand in order to postpone the need for water system expansion, to identify potential uses for wastewater and stormwater, and to promote responsible management of water resources. The guide's self-help format, complete with questions and instructions, enables municipalities to perform an audit without outside assistance and to repeat the procedure when necessary. (Author's abstract)
W87-08953

CURBING THMS IN SMALL WATER SYSTEMS,
Iowa State Univ., Ames. Dept. of Civil Engineering.
A. D. Levine, E. R. Baumann, and L. B. Lind.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 5, p 52-56, May 1987. 5 tab, 18 ref.

Descriptors: *Water supply, *Trihalomethanes, *Water treatment, *Iowa, Surveys.

Under current federal law, public water supplies that serve fewer than 10,000 people are not required to monitor or control trihalomethanes (THMs). Small water utilities in Iowa were surveyed to determine whether THM contamination is a problem and to identify measures for THM control appropriate for small utilities. Grab samples were collected in July and August 1983 and September 1984 from treatment facilities and from distribution systems in communities with fewer than 10,000 residents. More than 75 percent of the communities had THM levels in excess of the maximum contaminant level. Treatment modifications that influence the formation of THMs are reviewed and control measures appropriate for small utilities are recommended. (Author's abstract)
W87-08954

APPLYING ECONOMIC PRINCIPLES TO SMALL WATER SYSTEMS,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 6C.
W87-08955

AIR-WATER PHASE EQUILIBRIA OF VOLATILE ORGANIC SOLUTES,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
C. Munz, and P. V. Roberts.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 5, p 62-69, May 1987. 11 fig, 3 tab, 41 ref. EPA Assistance agreement CR-808851.

Descriptors: *Water treatment, *Volatile organic compounds, *Air stripping, *Henry's law, *Model studies, Thermodynamics, Vapor pressure, Solubility, Solvents, Solutes, Temperature effects.

The equilibrium or Henry's constant, H sub c and the mass transfer rate constant, K sub L(a), are the major factors determining the extent of transfer during bubble aeration and in countercurrent packed columns. This study delineates the limits of validity of Henry's law for nonionizing halogenated solutes and presents data on the effects of temperature and the addition of model cosolvents on the Henry's constant. The experimental results are compared with predictions from a semi-empirical thermodynamic model and from vapor pressure and solubility data. No effect of solute concentration on the solute's Henry's constant was observed up to solute liquid mole fractions of .001. Very high cosolvent concentrations, in excess of 10 g/L, are required to reduce the solute's Henry's constant. The Henry's constant of the organic compounds studied increases by a factor of approximately 1.6 with each 10 C rise in temperature, representing a very strong effect. Thus, temperature is likely to be a key parameter affecting the extent of removal of volatile organic compounds in gas-liquid contacting processes. (Author's abstract)
W87-08956

OPERATIONAL VARIABLES AND THE RELEASE OF COLONIZED GRANULAR ACTIVATED CARBON PARTICLES IN DRINKING WATER,
Montana State Univ., Bozeman. Dept. of Microbiology.
A. K. Camper, S. C. Broadaway, M. W. LeChevallier, and G. A. McFeters.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 5, p 70-74, May 1987. 6 tab, 27 ref. EPA CR810015.

Descriptors: *Water treatment, *Carbon filters, *Activated carbon, *Filtration, *Drinking water, Bacteria, Statistical analysis, Turbidity.

Laboratory and field studies were conducted to determine the impact of granular activated carbon (GAC) drinking water filters and various operational variables on the release of populated filtration medium into finished water. Initially, various filtration media were compared. In laboratory column experiments, the surfaces of GAC, sand, and anthracite particles were populated to the same level with heterotrophic plate count (HPC) bacteria. However, GAC supported greater numbers of the coliform Klebsiella oxytoca than the other two media. A comparison of the media from operating drinking water filters showed that GAC-filtered water contained particles with attached HPC and coliform bacteria to a greater extent than sand- and anthracite-treated water. The involvement of various operational variables in the increased release of populated fines was evaluated at two facilities. Statistical analyses showed that GAC age does not affect the occurrence of populated fines in filtered water. However, a deeper GAC bed, an increase in applied water turbidity, and an elevated filtration rate were implicated as contributing to the presence of populated filtration medium in drinking water. (Author's abstract)

W87-08957

OCCURRENCE, SIGNIFICANCE, AND DETECTION OF KLEBSIELLA IN WATER SYSTEMS,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 5A.
W87-08958

COMMITTEE REPORT: MICROBIOLOGICAL CONSIDERATIONS FOR DRINKING WATER REGULATION REVISIONS,
American Water Works Association, New York.
E. E. Geldreich, A. E. Greenberg, C. N. Haas, J. C. Hoff, and R. J. Karlin.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 5, p 81-84, 88, May 1987. 4 ref.

Descriptors: *Water quality, *Microbiological studies, *Water treatment, *Drinking water, *Regulations, Reviews.

Because of the importance of the microbiological quality of water, the AWWA Organisms in Water Committee elected to review the various options and approaches that had been proposed in connection with revised drinking water regulations. This report addresses these proposals, as well as current practice, and summarizes the committee's concerns and recommendations. (Author's abstract)
W87-08959

PRODUCTION FUNCTIONS FOR WATER DELIVERY SYSTEMS: ANALYSIS AND ESTIMATION USING DUAL COST FUNCTION AND IMPLICIT PRICE SPECIFICATIONS,
Claremont McKenna Coll., CA. Dept. of Economics.
For primary bibliographic entry see Field 6D.
W87-09014

HANDBOOK OF PUBLIC WATER SYSTEMS.
Van Nostrand Reinhold Co., New York, NY. 1986. 1113 p. Edited by Robert B. Williams and Gordon L. Culp.

Descriptors: *Handbooks, *Water conveyance, *Municipal water, *Water treatment, *Water treatment facilities, Cost-benefit analysis, Research priorities, Trihalomethanes, Sludge, Waste disposal.

This book demonstrates innovative and cost-efficient techniques for designing and operating public water systems, provides data from current water system research, evaluates applications of new water treatment methods, and analyzes water project costs. Topics of special interest includes: (1) trihalomethane (THM) removal and control - how to keep THM levels below recently specified maximum concentrations; (2) small water treatment systems - provides the first comprehensive evaluation of affordable treatment methods for small municipal systems; (3) energy conservation techniques - how to select equipment and methods that reduce the rising energy costs of water treatment; (4) sludge handling and disposal - how to comply with newly mandated restrictions; (5) source development - how to design surface and groundwater sources that avoid the harmful effects of past practices. Also included are the full details on pumping systems, upgrading existing water treatment plants, and pretreatment processes for surface water supplies. (Lantz-PTT)
W87-09063

HANDBOOK OF CHLORINATION,
For primary bibliographic entry see Field 5D.
W87-09064

SAFE DRINKING WATER: THE IMPACT OF CHEMICALS ON A LIMITED RESOURCE.
Drinking Water Research Foundation, Alexandria, VA.
For primary bibliographic entry see Field 5C.
W87-09114

CHEMICALS AND SAFE DRINKING WATER: NATIONAL AND INTERNATIONAL PERSPECTIVE,
Chemical Industry Inst. of Toxicology, Research Triangle Park, NC.
For primary bibliographic entry see Field 5C.
W87-09115

DRINKING WATER: A GLOBAL VICTUAL,
Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
For primary bibliographic entry see Field 5C.
W87-09116

PUBLIC DRINKING WATER AND CHEMICALS,
American Water Works Association Research Foundation, Denver, CO.
For primary bibliographic entry see Field 5C.
W87-09117

BOTTLED WATER: AN ALTERNATIVE SOURCE OF SAFE DRINKING WATER,
McKesson Operations Resource Group, San Francisco, California. Government Relations and Scientific Affairs.
J. T. Hutton.
IN: Safe Drinking Water: The Impact of Chemicals on a Limited Resource. Lewis Publishers, Chelsea, Michigan. 1985. p 33-41, 1 fig, 1 tab.

Descriptors: *Drinking water, *Water treatment, *Bottled water, *Public health, Ozonation, Filtration, Organoleptic properties, Consumptive use, Potable water, Water quality control.

The number of Americans drinking bottled water is increasing by 10% every year. Bottled water is used for medical reasons where low sodium and low nitrate levels are prescribed, for emergency situations caused by natural disasters or by pollution of water supplies, and for aesthetic reasons of good taste, color and odor. Per capita consumption of bottled water is greatest in the Southwest, where growing populations and limited water supplies combine to push total dissolved solids levels up and consumer acceptance down. Most bottled water users are served by direct delivery of large 5-gallon bottles to homes, offices, factories, hospitals, and public facilities. The bottled water industry is represented by a trade association, the International Bottled Water Association, headquartered in Alexandria, Virginia. The industry distributes four generic types of bottled water, all of which must be derived from a protected source. All bottled water is processed in some manner, usually by ozonation, or membrane filtration. Bottled water is regulated by the Food and Drug Administration. It must also meet EPA's Interim Primary and all Secondary Drinking Water Standards. In addition to government regulation, the industry employs the American Sanitation Institute to audit the performance of each member company in providing quality drinking water. The possible contributions of bottled water to the nations's future safe drinking water programs in terms of safety, availability, and cost are discussed. (See also W87-09114) (Geiger-PTT)
W87-09118

OVERVIEW OF POINT-OF-USE WATER TREATMENT TECHNOLOGY,
Everpure, Inc., Westmont, IL.
P. Regunathan.
IN: Safe Drinking Water: The Impact of Chemicals on a Limited Resource. Lewis Publishers, Chelsea, Michigan. 1985. p 43-62, 8 fig, 6 tab, 10 ref.

Descriptors: *Water treatment, *Drinking water, *Activated carbon, *Filtration, *Chemical treatment, Organic compounds, Turbidity, Disinfection, Water softening, Domestic use, Dissolved solids, Cost analysis, Anion exchange, Reverse osmosis, Hardness.

The treatment of water at the point of use (POU) has increased many fold during the last ten years to meet the real and perceived needs of the consumers of the United States. While most POU units are acquired for the improvement of aesthetic qualities, more and more devices are becoming available to reduce the concentration of health-related contaminants in some water supplies. Existing POU units include softeners to remove hardness, adsorption filters for the removal of dissolved organics, particulate filters for removing turbidity, cysts, and asbestos fibers, and reverse osmosis-activated carbon systems to remove dissolved minerals along with other contaminants. Types of POU units discussed include: granular beds, spool filters, pleated filters, precoat filters, reverse osmosis units, and other miscellaneous units. In the home these units may appear as faucet add-on units, under-the-sink units, whole household units, and unplumbed units. While the POU unit is still predominantly required for removal of taste, odor, visible dust, and rust, removal of health-related organic and inorganic compounds is gaining importance in the industry. POU units containing activated carbon have been of practical use in removing or reducing levels of various volatile organics. Home water softening units are useful in removing heavy metals. POU products designed for particulate removal vary widely according to their applications. Studies have shown that bacteria can grow on the effluent side of POU systems. As of yet, no effective bacteriostat has been developed for use in POU devices. Other studies have shown the economic viability of the POU approach compared to central treatment. (See also W87-09114) (Geiger-PTT)
W87-09119

EFFECTIVE ALTERNATIVE TO OFFICIAL REGULATION OF INDIRECT ADDITIVES TO DRINKING WATER,
National Sanitation Foundation, Ann Arbor, MI.
N. I. McClelland.
IN: Safe Drinking Water: The Impact of Chemicals on a Limited Resource. Lewis Publishers, Chelsea, Michigan. 1985. p 63-81, 4 fig, 5 tab, 20 ref.

Descriptors: *Drinking water, *Water treatment, *Chemical treatment, *Pesticides, *Water quality standards, Organic compounds, Leaching, Public health, Toxicity, Regulations, Plumbing, Plastics, Water quality control.

The U. S. Environmental Protection Agency has authority to regulate substances in drinking water when the water is a public supply serving over 25 people. The EPA has established primary standards (maximum contaminant levels) for ten inorganic chemicals, six pesticides, total trihalomethanes, radionuclides, coliform bacteria, and turbidity. In addition, the EPA is granted emergency powers and provides technical guidance through its program of Health Advisories. To deal with the issue of additives, EPA established an Additives Evaluation Branch in 1980. Products which may contribute indirect additives to drinking water include pipes, fittings, and appurtenances used as components of distribution and plumbing systems; paints, coatings; joining materials, including caulks and sealants, films and liners; and other items which are in direct contact with the water. Many studies report leaching of toxic compounds into water from indirect sources. Risk-benefit analyses must be performed to assess the effects of indirect additives on public health and the costs of correcting these problems. The National Sanitation Foundation (NSF) has established minimum public health and safety requirements for thermoset and termoplastic pipes, fittings, valves, tanks, joining materials, appurtenances, and plastic coatings for potable water and drainage applications. Chemical leachate testing is required for all proposed new ingredients under NSF Standard 14. All NSF standards have a requirement for periodic review at intervals not to exceed five years. This type of comprehensive, cooperative regulatory industry program is an effective alternative to official regulation of indirect additives to drinking water. (See W87-09114) (Geiger-PTT)
W87-09120

WATER TREATMENT CHEMICALS CODEX,
National Research Council, Washington, DC.

Food and Nutrition Board.
R. E. Rehwoldt.
IN: Safe Drinking Water: The Impact of Chemicals on a Limited Resource. Lewis Publishers, Chelsea, Michigan. 1985. p 83-85.

Descriptors: *Water treatment, *Toxicity, *Water quality standards, *Drinking water, Potable water, Regulations, Water quality control.

The National Academy of Sciences Committee on Water Treatment Chemicals formulated a Water Treatment Chemicals Codex to supplement existing compendia on water treatment chemicals. The Codex is confined to information on purity as it is related to health and does not address product performance, packaging, storage, or handling. The committee also developed a list of impurities occurring from water treatment chemicals and supplied toxicological data on these substances, including information on possible genotoxic or epigenetic effects. The Maximum Contaminant Level (MCL) was used for calculating the allowable contaminant level contributed by an impurity in a water treatment chemical. An MCL was converted to a Recommended Maximum Impurity Content (RMIC) by an equation which divided the MCL by the product of the maximum dosage and a safety factor. The maximum dosage for the water treatment chemical was based on maximum patterns known by the committee to be representative of water treatment practice. The safety factor used in the calculation of the RMIC was 10, reflecting the view of the committee that no more than 10% of a given MCL value should be contributed by a given impurity in a water treatment chemical. The Codex contains RMIC values for impurities of concern at selected additive dose levels, which are reported to one significant figure. RMIC values defining the purity of each water treatment chemical also are contained in individual monographs and may be used as guidelines for the water works industry. At present, the Codex contains 34 monographs. The Codex will be reviewed continuously and annual supplements will be issued. (See also W87-09114) (Geiger-PTT)
W87-09121

DISINFECTANT CHEMISTRY IN DRINKING WATER - OVERVIEW OF IMPACTS ON DRINKING WATER QUALITY,
Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
A. A. Stevens, L. Moore, R. C. Dressman, and D. R. Seeger.
IN: Safe Drinking Water: The Impact of Chemicals on a Limited Resource. Lewis Publishers, Chelsea, Michigan. 1985. p 87-108, 9 fig, 3 tab, 11 ref.

Descriptors: *Drinking water, *Disinfection, *Water treatment, *Water quality, *Chlorination, Chlorine, Ozonation, Ozone, Residual chlorine, Organic compounds, Organic acids, Hydrogen ion concentration, Chemical treatment.

Disinfection power, ease of application, and low cost have made free chlorine an attractive choice as the primary disinfectant in drinking water treatment. Discovery of trihalomethanes, formed by the action of free chlorine upon natural organic materials such as aquatic humic materials, has led to a reexamination of this practice. A change to an alternative disinfectant, such as chloramines, chlorine dioxide, or ozone either has occurred or is being contemplated by utilities that have difficulty meeting the maximum contaminant level requirement for trihalomethanes. These alternative disinfectants when used alone do not usually cause significant formation of trihalomethanes. Each is an active oxidant, however, and has the potentinal of forming objectionable byproducts other than trihalomethanes. Free chlorine forms organic halogen levels substantially in excess of those accounted for by the trihalomethanes. Chloramines and chlorine dioxide do also, althouh less than does free chlorine. Increasing numbers of specific reaction products of each disinfectant in aqueous solution are now being observed, and some are being identified. The beneficial use of each of the chemicals as a biocide in drinking water treatment may have its own less desirable side effects. (See also W87-09114) (Geiger-PTT)
W87-09122

BY-PRODUCTS OF CHLORINATION: SPECIFIC COMPOUNDS AND THEIR RELATIONSHIP TO TOTAL ORGANIC HALOGEN,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. L. Norwood, G. P. Thompson, J. J. St. Aubin, D. S. Millington, and R. F. Christman.
IN: Safe Drinking Water: The Impact of Chemicals on a Limited Resource. Lewis Publishers, Chelsea, Michigan. 1985. p 109-121, 3 fig, 4 tab, 21 ref.

Descriptors: *Chlorination, *Drinking water, *Water treatment, *Chlorine, *Disinfection, Chloroform, Organic compounds, Humic acids, Halogens, Fulvic acids, Chemical treatment, Water quality, Natural waters.

Over the past decade a great deal of scientific interest had focused on the hydrophobic halogenated by-products of drinking water disinfection, principally chloroform and other trihalomethanes. Natural aquatic humic material has been implicated as a precursor for these substances. More recent data suggests that the importance of chloroform as an aqueous chlorination product of humic materials may have been overstated. This study reviews the progress to date on the identification and quantification of more hydrophilic chlorination by-products, such as trichloroacetic acid, from a variety of humic substances. Qualitative data are summarized from several previous studies and compared with more recent experiments performed in the authors' laboratory on isolated aquatic humic material. Data are reported which support the hypothesis that these hydrophilic substances are produced in greater yield than chloroform and account for a significant fraction of the total organic halogen materials produced. (See also W87-09114) (Author's abstract)
W87-09123

OZONE FOR DRINKING WATER TREATMENT - EVOLUTION AND PRESENT STATUS,
Rice (Rip G.), Inc., Ashton, MD.
R. G. Rice.
IN: Safe Drinking Water: The Impact of Chemicals on a Limited Resource. Lewis Publishers, Chelsea, Michigan. 1985. p 123-159, 8 fig, 7 tab, 28 ref.

Descriptors: *Drinking water, *Water treatment, *Disinfection, *Ozone, *Ozonation, Organic compounds, Organic matter, Turbidity, Color, Algae control, Viruses, Chlorine, Water quality, Chlorine residual, Chemical treatment, Cost analysis.

Since its adoption by the City of Nice, France in 1906 for disinfection of drinking water, the use of ozone as a water treatment agent has grown in importance. Early installations used ozone primarily for disinfection at the end of the treatment process. In modern times, however, the use of ozone as a chemical oxidant during early stages of water treatment have become prevalent. In light of current recognition of problems of organics in drinking water, modern water treatment facilties are learning how to combine ozone as a chemical oxidant with other water treatment steps, including ozone disinfection. The overall benefit of two- or three-stage ozonation to the improved quality of water becomes one of removing detrimental organic materials to minimize the amount of chlorine compound residual required for the distribution system. (See W87-09114) (Author's abstract)
W87-09124

REGULATION OF CONTAMINANTS IN DRINKING WATER,
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
J. A. Cotruvo.
IN: Safe Drinking Water: The Impact of Chemicals on a Limited Resource. Lewis Publishers, Chelsea, Michigan. 1985. p 183-195, 10 tab.

Descriptors: *Drinking water, *Water quality control, *Water quality standards, *Water pollution control, *Regulations, Organic compounds, Inorganic compounds, Groundwater pollution, Disinfection, Water treatment, Coliforms, Turbidity, Public health, Viruses, Pesticides.

The public needs to feel confident that their drinking water is safe. The activities being conducted by the EPA to ensure safe drinking water are reviewed. Interim drinking water regulations in the United States involve approximately 40 substances. They include the traditional biological contaminants, coliforms and turbidity; a spectrum of inorganic contaminants that are still most frequently found in drinking water from various sources; six organic pesticides; radionuclides, and trihalomethanes. Phase I regulations deal with volatile synthetic organics. Phase II regulations are concerned with organic compounds and pesticides, inorganic chemicals, and microbials. Phase IIA regulations take into account fluoride. Phase III regulations deal with radionuclides. Phase IV regulations consider disinfection by-products, especially trihalomethanes. Three areas need to be emphasized in providing safe drinking water: preventing contamination of drinking water sources; providing treatment when it is needed, that is tailored to the type of contamination; and monitoring to determine what is in the water so that action may be taken to deal with contaminants. (See also W87-09114) (Geiger-PTT)
W87-09128

REGULATORY FLEXIBILITY AND CONSUMER OPTIONS UNDER THE SAFE DRINKING WATER ACT,
Kadison, Pfaelzer, Woodward, Quinn, and Rossi, Washington, DC.
T. L. Harker.
IN: Safe Drinking Water: The Impact of Chemicals on a Limited Resource. Lewis Publishers, Chelsea, Michigan. 1985. p 209-221, 1 tab, 13 ref.

Descriptors: *Water law, *Safe Drinking Water Act, *Drinking water, *Bottled water, *Water quality standards, Water quality control, Water pollution control, Public health, Cost analysis, Organic compounds, Water treatment, Disinfection, Inorganic compounds, Regulations, Water supply.

Hazardous waste contamination of public and private water supplies, and the financial instability of many small public treatment systems to comply with the Safe Drinking Water Act often force state and local governments to seek alternatives to centralized treatment as sources of safe drinking water. Bottled water is a principal alternative soruce for use in emergencies and on an interim or permanent basis for small public water supply systems. Bottled water can serve as a permanent supply of potable water for an entire small community or non-comunity system, or for residential areas served by private wells in an aquifer that has become contaminated. This option is attractive when centralized treatment is costly. Bottled water can serve as a temporary solution during the intermediate period while permanent centralized solutions are being devised. Bottled water may be used by water systems facing water quality problems due to an emergency situation. The use of bottled water has been expressly recognized by the U. S. Army Corps of Engineers, the Federal Emergency Water Administration and the U. S. EPA under the National Contingency Plan for responding to contamination of drinking water supplies. Bottled water can serve as a permanent alternative source for special segments of the population such as small children and pregnant women who require low nitrate levels in the water supply. The Safe Drinking Water Act allows EPA to authorize the use of bottled water, where appropriate, to achieve the goals of the Act. Other government policies authorizing the use of bottled water to meet drinking water needs are EPA's National Contingency Plan under the Superfund Act, the Department of Interior's Emergency Water Supply Plan, and The U. S. Army Corps of Engineers' Emergency Water Plan. (See W87-09114) (Geiger-PTT)
W87-09131

STRUCTURE AND REGULATION OF THE EUROPEAN BOTTLED WATER INDUSTRY,

Rice (Rip G.), Inc. Aston, MD.
R. G. Rice, and G. W. Miller.
IN: Safe Drinking Water: The Impact of Chemicals on a Limited Resource. Lewis Publishers, Chelsea, Michigan. 1985. p 223-254, 8 tab, 16 ref.

Descriptors: *Bottled water, *Drinking water, *Water quality control, *Regulations, *Water quality standards, Mineral water, Mineral springs, Ozonation, Ozone, Disinfection, Water treatment, Groundwater, Consumptive use.

In the United States, bottled water is an alternative option to municipal drinking water. This is because U. S. bottled water either is groundwater which is disinfected by ozone (not chlorine) as it is bottled, or is municipal tap water which has been treated with granular activated carbon (to remove chlorine and other dissolved organics), and with deionizing resins (to remove inorganics). Specific levels of minerals then are added, and the water is ozonized as it is bottled. As a result, U. S. bottled waters do not contain the chlorinous tastes and odors sometimes prevalent in U. S. municipal tap waters. On the other hand, European tap waters also are either clean groundwaters, or are surface waters which are treated by a combination of processes such that they do not contain chlorinous tastes and odors. As a result, in Europe the bottled water is not an alternative to municipal tap waters. (See also W87-09114) (Author's abstract)
W87-09132

HANDBOOK OF OZONE TECHNOLOGY AND APPLICATIONS VOLUME II: OZONE FOR DRINKING WATER TREATMENT.
Butterworth Publishers, Boston, MA. An Ann Arbor Science Book. 1984. 378 p. Edited by Rip G. Rice and Aharan Netzer.

Descriptors: *Ozonation, *Disinfection, *Water treatment, *Handbooks, *Drinking water, Ozone, Potable water, Viruses, Microflocculation, Manganese, Iron.

The application of ozone for the treatment of drinking waters is discussed in this volume of 'The Handbook of Ozone Technology and Applications.' Many contributions in this book describe some of the more important applications of ozone for treating drinking water. Because most of the development of these applications of ozone have been made in Europe, the editors have drawn upon European experts in the field for most of these contributions. The first chapter describes the principles of ozone disinfection of drinking water, was they have evolved in France. Conditions are described under which ozone not only provides bacterial disinfection, but also inactivation of common viruses. This initial chapter is followed by discussions of removal of iron and manganese at the Dusseldorf (Federal Republic of Germany) Water Works, which has employed ozone for this and other purposes since the mid-1950s. Three chapters written by German experts deal with microflocculation caused by ozonation, the generation of ozone from oxygen (used since the early 1970s for closed loop application in the full-scale water treatment plant in Duisburg, Federal Republic of Germany) and the use of ozone to promote biological activity. A chapter describing recent advances in drinking water treatment with ozone is next, and this volume concludes with a bibliography of more than 1,600 literature citations on the subject, subdivided into 32 individual categories, in order to provide more ready access for the reader interested in specific subtopics. (See W87-09135 thru W87-09147) (Lantz-PTT)
W87-09134

OZONE DISINFECTION OF DRINKING WATER,
J.-P. Legeron.
IN: Handbook of Ozone Technology and Applications Volume II: Ozone for Drinking Water Treatment, Butterworth Publishers, Boston, MA. An Ann Arbor Science Book. 1984. p 1-20, 9 fig, 17 ref.

Descriptors: *Ozonation, *Disinfection, *Drinking water, Water treatment, Potable water, Chlorine, Chloramine, France, Water quality control, Standards.

Ozonation may be used safely as the sole means of water disinfection if true ozonation is employed and if the physicochemical properties of the water before disinfection are up to par. In addition, the quality of finished water disinfected solely with ozone must be preserved all the way to the consumer. This may be accomplished naturally when the water has a short travel time in the network, low temperature and good original quality, and the distribution system is new or in excellent condition (no leaks). In contrary cases, it is necessary to add a disinfectant with more lasting qualities (chlorine, chlorine dioxide, chloramine), whose small application dosages will not significantly affect distributed water quality. Ozone disinfection was born in France (the method has been in commercial use for drinking water purification for 75 years in Nice) and its use has since spread worldwide. The criteria for perfect disinfection - the rule of maintaining 0.4 mg 03/L for 4 min - also have French roots, and their application over the past twenty years to waters of very different origins has allowed supply of consumers with millions of cubic meters of water that comply rigorously with public health standards. Another decisive step in the practice of ozonation was made more recently: automation of the process using electronic computers linked to sensors that continuously and automatically provide them with the essential data. At all times and without human intervention, ozone production is controlled according to the ozone demand of the water. This is a significant advance in the treatment process, allowing both security of water quality and savings in costs for this vital purification stage. (See also W87-09134) (Lantz-PTT)
W87-09135

REMOVAL OF IRON AND MANGANESE BY OZONE DURING DRINKING WATER TREATMENT IN DUSSELDORF,
Dusseldorf Waterworks (Germany, F.R.).
F. J. Weissenhorn.
IN: Handbook of Ozone Technology and Applications, Volume II: Ozone for Drinking Water Treatment, Butterworth Publishers, Boston, MA. An Ann Arbor Science Book. 1984. p 21-29, 7 fig, 3 ref.

Descriptors: *Iron, *Manganese, *Water treatment, *Ozonation, *Drinking water, *Dusseldorf, *Rhine River, Rivers, Filtration, Oxidation, Chemical treatment.

Up until the 1950s, riverbank filtration (uferfiltration) of Rhine river water had sufficed to yield unobjectionable drinking water, without requiring further treatment by physicochemical processes. Subsequently, however, the oxygen deficit of riverbank-filtered water grew with increased loading of the Rhine with various wastewaters. These contaminants resulted in the initiation of underground reductive microbiological activity during passage of the waters through the river sand banks, whereby oxygen-rich compounds of iron and manganese became chemically reduced and thus dissolved in the water. As a result, maximal concentrations of these metals reached levels of 0.1 - 0.5 g/cu m in riverbank-filtered waters. Further, because of increasing discharges of industrial wastewaters into the Rhine river, the water acquired such poor odor and taste characteristics that additional treatment was required. Extraction of riverbank-filtered water, Dusseldorf water treatment processes, chemistry of iron and manganese oxidation with ozone, and ozonation of riverbank-filtered water, are presented in this discussion of the water treatment process in Dusseldorf. (See also W87-09134) (Lantz-PTT)
W87-09136

CONTROL OF TASTES AND ODORS IN DRINKING WATER WITH OZONE,
Societe Degremont, Rueil-Malmaison (France).
Y. Richard, and L. Brener.
IN: Handbook of Ozone Technology and Applications, Volume II: Ozone for Drinking Water Treatment, Butterworth Publishers, Boston, MA. An Ann Arbor Science Book. 1984. p 31-48, 7 fig, 4 tab, 44 ref.

Descriptors: *Water treatment, *Water quality control, *Drinking water, *Ozonation, *Tastes, *Odor control, Potable water, Water quality, Activated carbon, Flocculation, Clarification, Temperature.

The palatibility, especially taste and odor, of water for human consumption has always been a matter of concern for public utilities and distribution companies. Indeed, people judge the quality of water by its limpidity, taste and color. These subjective criteria are difficult to define, as they are not based on chemical and biological considerations. Ozone is very effective for destroying many (but not necessarily all) bad tastes and odors in drinking water. However, bad taste may be caused by several substances at once. A two-stage treatment is possible, for example, with powdered activated carbon (with simultaneous flocculation and clarification) followed by final treatment with ozone after filtration. In practice, both processes sometimes are needed to remove all odors. The action of ozone can vary with temperature. Below 5 C, it sometimes has only a limited action on taste-producing constituents. This is why it often is useful to combine ozone with activated carbon when the water to be treated varies widely in temperature. (See also W87-09134) (Lantz-PTT)
W87-09137

REMOVAL OF COLOR FROM DRINKING WATER WITH OZONE,
Societe Degremont, Rueil-Malmaison (France).
Y. Richard, and L. Brener.
IN: Handbook of Ozone Technology and Applications, Volume II: Ozone for Drinking Water Treatment, Butterworth Publishers, Boston, MA. An Ann Arbor Science Book. 1984. p 49-62, 9 fig, 5 tab, 22 ref.

Descriptors: *Drinking water, *Water treatment, *Water quality, *Ozonation, *Color removal, Decomposing organic matter, Hydrogen ion concentration, Temperature, Decomposition, Ozone, Organic matter, Iron, Manganese.

Colored waters occur widely in nature, and they raise many problems when used for domestic or industrial purposes. It is now known that the color of waters comes mainly from the presence of humic substances in the water. These substances arise from decomposition of plant material, either in the ground or directly in the water. The color intensity of these waters depends on the nature and quantity of materials undergoing decomposition. The following factors affect the color of the waters: (1) contact time with the materials undergoing decomposition; (2) temperature (in tropical and subtropical countries, the decomposition process is very fast); and (3) pH of the water. In some cases, the color also can have seasonal causes: rapid growths of larvae and algae appear, giving the water a temporary color. Two cases can be considered, according to whether ozone is used at the end of or during treatment. If ozone is introduced at the end of the treatment process, proper removal of organic matter, and iron and manganese must be assured. Ozone then permits improvement of residual color in the distributed water. Applied dosages ranges between 0.7 and 2 gm/cu m. If ozone is used for preliminary treatment, doses required for color removal will be higher, due to the interference of other constituents in water. In this case, ozone should be used in combination with other processes (microstraining, coagulation, flocculation, settling, filtration). Each case should be studied specifically, to define the best possible solution to the specific color problem. (See also W87-09134) (Lantz-PTT)
W87-09138

REMOVAL OF DETERGENTS FROM DRINKING WATER WITH OZONE,
Societe Degremont, Rueil-Malmaison (France).
Y. Richard, and L. Brener.
IN: Handbook of Ozone Technology and Applications, Volume II: Ozone for Drinking Water Treatment, Butterworth Publishers, Boston, MA. An Ann Arbor Science Book. 1984. p 63-75, 11 fig, 1

tab, 10 ref.

Descriptors: *Detergents, *Drinking water, *Water treatment, *Ozonation, Surfactants, Soaps, Sodium alkylbenzensulfonates, Biological oxygen demand, Degradation.

Ozone canb be used to remove detergents from drinking water. The significant increase in detergent use shortly after World War II and their distribution within the environment had prejudicial effects on aqueous media: inhibiting effects on bacteria and toxic effects on fish. Anionic detergent concentrations of 2-3 mg/L in water led to considerable sudsing, which disturbs settling processes. Furthermore, sequestering and complex-forming agents (polyphosphates) can affect flocculation and sedimentation processes. The most prejudicial effect of so-called hard detergents is their nonbiodegradability by microorganisms and their persistence in the environment. Comparing five-day BOD5 and COD measured, showed the variable cation of ozone on various sulfonic or nonsulfonic, aromatic molecules. A ratio of 0.8 indicates an optimum biological degradability. Studies have shown that ozone introduction increased BOD5. However, BOD5 decreased as more ozone was added. Twice as much ozone was required to reduce the level of BOD5 in the effluent to which 10 mg/L of sodium alkylbenzensulfonate (ABS) has been added. Over a range of ozone dosage up to 180 mg/L, methylene blue measurement revealed a null ABS concentration. Measurement of the BOD5/COD ratio shows that beyond an applied ozone dosage corresponding to the removal of 6 mg/L ABS, ozone considerably alters the detergent structure, whose by-products become assimilable by bacteria. Regulations have led to increasingly extensive use of biodegradable detergents. In general, ozone destroys the detergents present in waters destined for consumption. Thus, ozone permits: (1) destruction of the detergent function; (2) reduction in COD levels; and (3) transformation of the molecule, resulting in a BOD5 increase. (See also W87-09134) (Lantz-PTT)
W87-09139

REMOVAL OF PESTICIDES FROM DRINKING WATER WITH OZONE,
Societe Degremont, Rueil-Malmaison (France).
Y. Richard, and L. Brener.
IN: Handbook of Ozone Technology and Applications, Volume II: Ozone for Drinking Water Treatment, Butterworth Publishers, Boston, MA. An Ann Arbor Science Book. 1984. p 77-97, 6 fig, 10 tab, 26 ref.

Descriptors: *Pesticides, *Drinking water, *Water treatment, *Ozonation, Water quality, Lindane, DDT, Parathion, Malathion, Herbicides, Triazine, Organic compounds, Clarification, Coagulation, Flocculation, Filtration.

Ozone can be used to remove some pesticides from drinking water. Their presence in water may result from direct application (to control aquatic insects and vegetation), soil leaching in agricultural regions and discharge of municipal or industrial wastes. Their persistence in natural media contributes to degraded water quality (toxicity, taste and odor). Effectiveness of ozonation on pesticides also corresponds to compound persistence in the natural environment: (1) persistent organochlorinated compounds (Lindane, DDT, etc.); (2) organosulfur-phosphorus compounds (Parathion, Malathion); (3) phenoxyacetic acid and ester-type herbicides (2,4-D, 2,4,5-T, MCPA); and (4) organonitrogen compounds (triazine). Clarification treatment processes (coagulation, flocculation, settling and sand filtration) remove these pesticides, which can be fixed or adsorbed onto the colloids or suspended solids, but have no effect on pesticides in solution. Few studies have been conducted on the specific action of ozone in pesticides. Particular attention must be paid to the form in which pesticides are found: adsorbed on suspended solids, chelated with dissolved organic matter or dissolved in the water to be treated. Ozone doses vary in each case. Tests on the natural water to be treated are recommended, since removal efficiencies obtained with concentrated solutions in the laboratory are often extremely different from those obtained on less concentrated, natural waters. As a general rule, organophosphorus pesticides, which are less stable than chlorinated organic pesticides in aqueous solutions, are better removed by ozonation. (See also W87-09134) (Lantz-PTT)
W87-09140

REMOVAL OF AMMONIA AND OTHER NITROGEN DERIVATIVES FROM DRINKING WATER WITH OZONE,
Societe Degremont, Rueil-Malmaison (France).
Y. Richard, and L. Brener.
IN: Handbook of Ozone Technology and Applications, Volume II: Ozone for Drinking Water Treatment, Butterworth Publishers, Boston, MA. An Ann Arbor Science Book. 1984. p 99-121, 17 fig, 6 tab, 14 ref.

Descriptors: *Ammonia, *Nitrogen, *Drinking water, *Water treatment, *Ozonation, Ozone, Chemical reactions, Reaction kinetics, Amino acids, TRyptophan, Tyrosine, Histidine, Cystine.

The oxidizing action of ozone on ammonia and nitrogen derivatives, and, more especially, on amino acids, is essential during disinfection processes. Ozonation of these compounds, which are the bases for all vital processes, also controls viruses and bacteria. The action of ozone on ammonia and amines, amino acid ozonation, and ozonation of ammonia are presented through discussions of reaction kinetics and chemical reactions involving tryptophan, tyrosine, histidine and cystine. (See also W87-09134) (Lantz-PTT)
W87-09141

MICROFLOCCULATION BY OZONE,
Zweckverband Bodenseewasserversorgung Uberlingen-Sussenmuhle (Germany, F.R.).
D. Maier.
IN: Handbook of Ozone Technology and Applications, Volume II: Ozone for Drinking Water Treatment, Butterworth Publishers, Boston, MA. An Ann Arbor Science Book. 1984. p 123-140, 11 fig, 1 tab, 31 ref.

Descriptors: *Microflocculation, *Ozone, *Water treatment, Ozonation, Chemical precipitation, Turbidity, Destabilization, Organic compounds, Flocculation.

Ozonation of the organic constituents of water gives rise to more polar compounds, richer in oxygen and poorer in double bonds, containing increased numbers of hydroxyl, carbonyl and carboxyl groups and having lower molecular weights. This ozone-induced change in structure is performed by two simultaneous and opposing processes. The first case - the production of precipitating products from originally dissolved organic compounds - is probably strongly dependent on the structure of the entire molecule. This includes the precipitation of insoluble alkaline earth metal salts of organic acids. Particularly in the case of lakewaters, there are indications that special metabolic products of the phytoplankton are made precipitable by ozonation. In practice, this phenomenon is observed as a turbidity increase after ozonation. The opposing process - destabilization of turbid suspensions by ozonated aqueous organic constituents - clearly should be regarded as true flocculation, the ozonated organic substances adsorbed on the turbidity-causing particles contributing (by bridge formation) to cross-linking of the particles as a result of their polyelectrolyte character. A decisive part is played here, not so much by the entire structure of the organic constituents as by the nature and quantity of their functional groups. In water treatment practice, the two processes presumably take place in opposing directions and, in addition, are dependent on turbulence. The reported investigations are partly the results of a research program on the optimization of the ozone process, promoted by the Water Economy Board. Some of the methods of characterizing aqueous organic constituents were newly developed within the framework of a research program for influencing corrosion processes with the aid of aqueous organic constituents. (See also W87-09134) (Lantz-PTT)
W87-09142

CLOSED-LOOP SYSTEM FOR GENERATING OZONE FROM OXYGEN AND ITS APPLICATION TO THE TREATMENT OF DRINKING WATER AT DUISBURG, FEDERAL REPUBLIC OF GERMANY,
Stadtwerke Duisberg A.G. (Germany, F.R.).
G. Uhlig.
IN: Handbook of Ozone Technology and Applications, Volume II: Ozone for Drinking Water Treatment, Butterworth Publishers, Boston, MA. An Ann Arbor Science Book. 1984. p 141-150, 6 fig, 9 ref.

Descriptors: *Ozone, *Water treatment, *West Germany, *Duisburg, Oxygen, Gasification, Economic aspects, Drinking water.

With the same energy consumption by ozone generators, at least twice the amount of ozone per hour can be obtained, in at least twice as high concentration, when ozone is produced from oxygen and not from air. Corresponding to this increase in concentration, ozone dissolution also increases for all types of gasification of the water. On application of additional pressure in suitable columns, the dissolution is higher by a factor of 10-30 than in the case of open gasification of the water with ozone produced from air. It is thereby possible to limit the gasification with ozone to a partial stream of water amounting to 3-10% of the raw water to be treated. Since the oxygen is recycled, none of the residual ozone need be wasted. The ozone is almost completely dissolved or goes to the return gas. At most, 10% of the amount of gas that must be transported and dried in the case of ozone production from air is conveyed to the gas recycle in the case of production from oxygen. This reduces the costs of gas drying and transportation, together with the energy balance for ozone production and costs of cooling the ozone generators. In the Duisburg, West Germany, process of ozonation of drinking water, these advantages were realized in 1966, corresponding to the state of technology at that time. So far, it has been the only process conceived for ozone treatment of the water under distribution system pressure in a closed system, and work on its improvement is continuing. (See also W87-09134) (Lantz-PTT)
W87-09143

BIOLOGICAL DRINKING WATER TREATMENT SYSTEMS INVOLVING OZONE,
Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.
M. R. Jekel.
IN: Handbook of Ozone Technology and Applications, Volume II: Ozone for Drinking Water Treatment, Butterworth Publishers, Boston, MA. An Ann Arbor Science Book. 1984. p 151-175, 8 fig, 2 tab, 37 ref.

Descriptors: *Drinking water, *Water treatment, *Ozonation, *Biological treatment, Organic compounds, Activated carbon, Disinfection, Biodegradation, Cost analysis, Ozonation, Filtration, Chemical processes.

Ozonation of water, polluted with considerable amounts of organics, will produce degradable substances that serve as substrates for microbiological processes. Application of ozone, therefcre, should not be the last treatment step. Additional disinfection or removal of biodegradable substances in a biological treatment process, e.g., slow sand, rapid inert media or activated carbon filtration, is necessary. Less ozone is needed to improve degradability compared with direct oxidation to carbon dioxide. Of special interest is the use of GAC in combination with preozonation, since considerable amounts of organic material are adsorbed and then degraded, thus extending the operational lifetime of carbon beds many-fold in some cases. Cost savings in carbon regeneration or replacement thus may outweigh the additional costs of ozonation. Further research is necessary on optimization of ozone dosage and distribution techniques, mechanisms of biological regeneration, and interaction of biofilms with adsorption kinetics and equilibria for specific trace organics to get the most benefit out of this process. (See also W87-09134) (Lantz-PTT)

W87-09144

RAW WATER PREOZONATION,
Compagnie Generale des Eaux, Paris (France).
J. Chedal.
IN: Handbook of Ozone Technology and Applications, Volume II: Ozone for Drinking Water Treatment, Butterworth Publishers, Boston, MA. An Ann Arbor Science Book. 1984. p 177-214, 25 fig, 9 tab, 29 ref.

Descriptors: *Raw water, *Ozonation, *Drinking water, *Water treatment, Chemical precipitation, Heavy metals, Clarification, Biological treatment, Ozone.

Ozone pretreatment of raw water facilitates precipitation of heavy metals. Its use in place of chlorination during physicochemical coagulation treatment presents the following advantages: (1) obtaining better clarification; (2) developing biological processes at the same time as clarification, including the possibility of nitrification; (3) lowering trihalomethane precursor levels; and (4) in many cases, increasing the rate of elimination of organic substances during clarification. With respect to this final point, continuation of research appears necessary. The observed deviations between different results for analogous test cannot presently be explained. Comprehension of the parameters governing these phenomena should permit optimization of preozonation treatment, which constitutes the first step of multistage ozonation. These reasons justify the recent development of this treatment. After having been applied mainly to lake- and dam water, ozonation is now used in treatment of raw river water (Langenau and Mulheim plants, FRG), in France at the Mery-sur-Oise plant (upstream from in-plant storage), and the Choisy-le-Roi plant (in association with coagulation treatment), and in the future Los Angeles plant in the United States. (See also W87-09134) (Lantz-PTT)
W87-09145

RECENT DEVELOPMENTS IN THE TREATMENT OF DRINKING WATER WITH OZONE,
Rice (Rip G.), Inc., Ashton, MD.
R. G. Rice.
IN: Handbook of Ozone Technology and Applications, Volume II: Ozone for Drinking Water Treatment, Butterworth Publishers, Boston, MA. An Ann Arbor Science Book. 1984. p 215-236, 10 fig, 3 tab, 18 ref.

Descriptors: *Water treatment, *Drinking water, *Ozone, *Paris, *France, *Karlsruhe, *West Germany, *Los Angeles, *New York, *Ozonation, Case studies, Filtration, Diatomaceous earth, Turbidity.

Several noteworthy advances have been reported concerning the use of ozone for treatment of drinking water supplies. Some of these represent first-of-a-kind water treatment procedures, which depend on several unique properties of ozone. Triple stage ozonation in suburban areas of Paris, France; Ozone treatment of contaminated groundwater: rejuvenation of the Karlsruhe drinking water treatment plant; Preozonation for removal of turbidity: the New Los Angeles, California, water treatment plant; and ozone/diatomaceous earth filtration: a new process for treatment of New York City water, are all case studies presented in this paper. These applications are reviewed briefly in this chapter. (See also W87-09134) (Lantz-PTT)
W87-09146

OZONE FOR DRINKING WATER TREATMENT: A BIBLIOGRAPHY,
Rice (Rip G.), Inc., Ashton, MD.
R. G. Rice.
IN: Handbook of Ozone Technology and Applications, Volume II: Ozone for Drinking Water Treatment, Butterworth Publishers, Boston, MA. An Ann Arbor Science Book. 1984. p 237-374.

Descriptors: *Ozone, *Bibliographies, *Water treatment, *Drinking water, *Ozonation.

In this paper, more than 1600 references are presented which deal with the application of ozone to the treatment of drinking waters. As an aid to the reader seeking literature dealing with specific topics, these articles have been grouped into 32 individual categories. Within each category, articles are listed alphabetically by last name of the senior author. In this manner, a reader interested specifically in the use of ozone to remove color from drinking waters, or to remove iron and manganese, or phenols, etc., can look under these individual categories. The listing of 32 individual categories is given below. Following the listing is a description of the rationale behind categorization of those articles whose titles and contents may not be readily apparent: general articles; review articles; bibliographies; basic parameters; analysis for ozone; contacting of ozone with water; destruction of ozone in contactor exhaust gases; disinfection and viral inactivation; ozone treatment of: algae, color, detergents, tastes and odors, inorganics, organics, pesticides, phenols, and humic/fulvic acids and trihalomethanes; oxidation products of organic materials; preozonation (of raw water); ozone/granular activated carbon (ozonation for promotion of biological activity); biological regrowth after ozonation; pilot-plant studies; full-scale ozone drinking water plants; instrumentation and automation; ozonation process control; protection of distribution systems; corrosion in ozone systems; materials of construction; toxicology and health and safety aspects of ozone; catalytic ozonation; ozone treatment of bottled water; and economics of ozone water treatment systems. This bibliographic listing does not include articles dealing with the ozone treatment of: swimming pool waters, cooling waters, seawater, and industrial process waters. (See also W87-09134) (Lantz-PTT)
W87-09147

RELATIONSHIP BETWEEN WATER-SYSTEM SIZE AND 222RN CONCENTRATION IN NORTH CAROLINA PUBLIC WATER SUPPLIES,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. P. Loomis.
Health Physics HLTPAO, Vol. 52, No. 1, p 69-71, January 1987. 2 tab, 6 ref.

Descriptors: *Radioisotopes, *Radon, *Water supply, *Public health, Geologic formations, Population exposure.

This study determined if water-system size is systematically related to 222Rn concentration in North Carolina. A functional relationship might exist between water system size and radon concentration because radon is more likely to escape to the atmosphere during the aeration that typically accompanies water treatment in larger public water systems, or to decay before it is transmitted to users through extensive distribution systems. Water-system size is a potential predictor of exposure. Concentration values of radon in public ground-water supplies decreased with increasing water-system size. But mean size of the water systems varied among systems located in geologically different areas. Systems in the coastal plain tended to be larger than systems in the Piedmont region, underlain by rocks which include granites, metavolcanics, gneisses and schists. Bedrock lithology is known to have a great influence on the radon content of ground water. The apparent inverse relationship between water system size and radon concentration appears to be due to differential distribution of different size water systems in areas of varying bedrock lithology. Thus, water system size may not be a predictor of exposure to radon independent of geologic and hydrologic variables. (McFarlane-PTT)
W87-09218

WATER TREATMENT: THE STATES ZERO IN ON GROUNDWATER REGULATION,
J. M. Winton, L. A. Rich, M. Bluestone, and L. J. Wilson.
Chemical Week CHWKA9, Vol. 140, No. 5, p 28-30, 34-36, 41-42, 44, 46, 48-50, 52, February 1987. 1 fig, 4 tab.

Descriptors: *Water treatment, *Wastewater treatment, *Groundwater, *Drinking water, Budgeting, Pesticides, Discharge measurement.

Reauthorization of the Clean Water Act will give further impetus to two major interrelated trends in water treatment. The first involves the increasing role that individual states are assuming in financing and regulating water treatment. The other is the emergence of groundwater protection as a major concern to state and federal authorities alike. State governments have long had the authority to run the federal National Pollutant Discharge Elimination System which involves the permitting of facilities to discharge wastewater into surface waters and to enforce pretreatment standards. But funding has been a major issue, as the Reagan administration attempted to end the construction grant program. The new CWA initiates a $400 million state-federal program to control nonpoint sources of pollution. It also establishes a new permitting program to control industrial amd municipal storm water discharges as point sources of pollution; focuses attention on toxic hot spots where controls beyond Best Available Technology Economically Achievable standards are needed to restore and protect water quality; introduces tighter restrictions on loopholes, variances, modifications and waivers and new requirements to prevent toxic contamination of sewage sludge at publicly owned treatment works. The Safe Drinking Water Act of 1986 could prove to be the major determinant of emerging groundwater policy. It has two major provisions: federal purity standards for drinking water and specific amendments on groundwater. The purity standards incorporate into law a list of 83 contaminants. The SDWA is the first attempt by Congress to legislate with respect to groundwater contamination. The states must identify wellhead protection areas, prescribe a program to keep contamination from damaging people, and can designate an aquifer as a sole-source aquifer when a population is dependent upon it for drinking water. (McFarlane-PTT)
W87-09222

REMOVAL OF INDIVIDUAL OFF-FLAVOUR COMPOUNDS IN WATER DURING ARTIFICIAL GROUNDWATER RECHARGE AND DURING TREATMENT BY ALUM COAGULATION/SAND FILTRATION,
Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
R. Savenhed, H. Boren, A. Grimvall, B. V. Lundgren, and P. Balmer.
Water Research WATRAG, Vol. 21, No. 3, p 277-283, March 1987. 4 fig, 1 tab, 17 ref.

Descriptors: *Water treatment, *Coagulation, *Sand filtration, *Artificial recharge, *Groundwater, *Taste, Odors, Chromatography, Performance evaluation.

The removal of individual off-flavor compounds during artificial groundwater recharge has been compared to the removal of such compounds during conventional alum coagulation/sand filtration. By using an evaluation technique based on gas chromatography with both instrumental and sensory detection ('column sniffing') it was shown that alum coagulation/sand filtration had no significant effect on any of the off-flavor compounds that could be detected in the raw water samples (geosmin, 2-methylisoborneol, 2-isopropyl-3-methoxypyrazine, 2,4,6-trichloroanisole, 1-octen-3-one, 1-nonen-3-one, dimethyl trisulphide and a number of unidentified muddy or musty odors). During artificial groundwater recharge in sand and gravel ridges, however, the concentrations of all these compounds were substantially reduced, thus proving that artificial groundwater recharge is not only a suitable method for water storage but can also be an effective method for removing muddy and musty odors. The successful use of the column-sniffing technique for evaluating water treatment methods has shown the potential of this technique in resolving some of the present disagreements concerning the effectiveness of different treatment methods for removing tastes and odors from water. (Author's abstract)
W87-09267

KINETICS AND MECHANISMS OF HYPOCHLORITE OXIDATION OF ALPHA-AMINO ACIDS AT THE TIME OF WATER DISINFECTION (CINETIQUES ET MECHANISMES DE L'ACTION OXYDATIVE DE L'HYPOCHLORITE SUR LES ACIDES ALPHA-AMINES LORS DE LA DESINFECTION DES EAUX),
Lab. de genie sanitaire, Ecole Nationale de la Sante Publique (ENSP), Avenue du Professeur Leon Bernard, 35043 Rennes Cedex, France.
Z. Alouini, and R. Seux.
Water Research WATRAG, Vol. 21, No. 3, p 335-343, March 1987. 6 fig, 2 tab, 13 ref.

Descriptors: *Fate of pollutants, *Hypochlorites, *Oxidation, *Amino acids, Kinetics, Chemical reactions, Chlorination, Disinfection, Water treatment.

In this study the hypochlorite oxidation of simple alpha-amino acids in aqueous solution has been investigated in the dark. The concentration of alpha(N-chloro) amino acid and alpha(N,N-dichloro) amino acid was monitored by DPD-fast titrimetric method and by measuring the absorbance at 255 and 293 nm respectively. These results and the amino acids determination (O-phthalaldehyde-2 mercapto ethanol method) suggest that the intermediates alpha(N-chloro) and alpha(N,N-dichloro) amino acid are formed rapidly at an initial stage. Then, they decompose spontaneously by first order kinetics to give a mixture of aldehyde and nitrile. When equimolar (1:1 mmol) amounts of hypochlorite and amino acid (acid pH or basic aqueous solutions with high molar ratio of hypochlorite and amino acid). The rate constant shows a dependence on pH, which is caused by the various forms that can arise from addition of protons to or removal of protons from the amino and carboxyl groups of the molecule. We assume an intermediate step of imine for the decomposition of both compounds: alpha(N-chloro) and alpha(N,N-dichloro) amino acid. The reaction should be considered as a spontaneous decarbonylation followed by a rapid hydrolysis of the imine. alpha(N,N-dicholo) amino acid can lead to the corresponding nitrile and aldehyde, however the alpha(N-chloro) amino acid gives only the corresponding aldehyde. The products of decomposition of alpha(N-chloro) amino acid are relatively stable in aqueous solution. Although we noted at pH = 3.5-5 that aldehyde react with chloramines and lead to the formation of corresponding nitrile. It appears that alpha(N-chloro) and alpha(N,N-dichloro) amino acid formed during the chlorination of natural or swimming pool water will degrade in a few hours to what are probably irritating products (such as aldehydes). The products of decomposition are a function of molar ratio of hypochlorite and amino acid and pH. However, since most natural water has a pH in the range of 5.5-9, there will be little variation of the rate of decomposition with pH. It seems that it is only temperature dependent. (Author's abstract)
W87-09274

TRIHALOMETHANE FORMATION IN WHIRLPOOL SPAS,
Environmental Health Directorate, Health and Welfare Canada, Environmental Health Centre, Tunney's Pasture, Ottawa, Ontario K1A 0l2.
For primary bibliographic entry see Field 5B.
W87-09276

METROPOLITAN WATER MANAGEMENT,
Denver Research Inst., CO. Industrial Economics Div.
For primary bibliographic entry see Field 6D.
W87-09338

EXPANSION OF GRANULAR FILTERS DURING BACKWASHING,
Dept. of Civil Engineering, Fac. of Engineering and Technology, Univ. of Jordan, Amman, Jordan.
For primary bibliographic entry see Field 5D.
W87-09371

COMPARISON OF BACKWASH MODELS FOR GRANULAR MEDIA,
Dept. of Civil Engineering, Fac. of Engineering and Technology, Univ. of Jordan, Amman, Jordan.
For primary bibliographic entry see Field 5D.
W87-09372

OPTIMAL WATER TREATMENT PLANT DESIGN,
Lab. Central de la Lyonnaise des Eaux, 38 rue du President Wilson, 78230 Le Pecq, France.
M. R. Wiesner, C. R. O'Melia, and J. L. Cohon.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 3, p 567-584, June 1987. 9 fig, 4 tab, 18 ref.

Descriptors: *Water treatment, *Optimization, *Design standards, *Model studies, *Filtration, *Cost analysis, Simulation, Particle size.

The identification of a least cost design and configuration of unit processes for particle removal in water treatment is formulated as a nonlinear optimization program. Simulation models describing changes in particle size and concentration enter into the formulation as constraints. Contact and direct filtration are found to be optimal treatment configurations at particle concentrations less than 15-20 mg/L. Reducing the number of unit processes in a water treatment plant does not always result in a decrease in cost. Results indicate that filter design traditionally relies on low filtration rates rather than pretreatment to ensure filtrate quality. (Author's abstract)
W87-09374

SEDIMENT DIFFUSION IN PRIMARY SHALLOW RECTANGULAR CLARIFIERS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
D. W. Ostendorf, and B. C. Botkin.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 3, p 595-611, June 1987. 6 fig, 1 tab, 23 ref, append.

Descriptors: *Sediment transport, *Clarifiers, *Model studies, *Turbulence, *Wastewater treatment, *Water treatment, *Settling velocity, Design standards, Prediction, Cost analysis, Calibrations.

The steady, diffusive transport of discretely settling, single-sized solids through a primary, shallow, rectangular clarifier is modeled in this study. The analysis proceeds in the assumed absence of fluid stratification, coagulation, unsteadiness, resuspension, wind, and short circuiting, although qualitative attention is given to some of these real-world phenomena. The inlet zone is identified as the dominant source of tank turbulence and an independent estimate of the resulting turbulent diffusivity is put forth, based on crude turbulent transport theory and data. A simple, analytical model of sediment transport through the settling zone is derived, and the resulting removal efficiencies are well-established functions of conventional design parameters. The predictions are successfully tested against laboratory data without calibration. Finally, a resuspension criterion yields a useful design constraint which is cast into a sizing algorithm for uniform sediment loads, predicted on the derived conclusion that shallow tanks are the most economical and efficient. (Author's abstract)
W87-09376

POTASSIUM FERRIOXALATE AS CHEMICAL ACTINOMETER IN ULTRAVIOLET REACTORS,
HYA Consulting Engineers, 1010 S. Baldwin Ave., Arcadia, CA 91006.
G. D. Harris, V. D. Adams, W. M. Moore, and D. L. Sorensen.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 3, p 612-627, June 1987. 3 fig, 3 tab, 20 ref. UWRL Project WR-91.

Descriptors: *Wastewater treatment, *Water treatment, *Potassium ferrioxalate, *Ultraviolet radiation, *Actinometry, *Disinfection, Bioassay, Bacteria, Costs, Design criteria.

The ultraviolet doses delivered by a quartz-sleeve and a Teflon-tube design ultraviolet disinfection reactor at various flow rates are estimated using a Bacillus subtilis bioassay and compared to dose estimates made using a potassium ferrioxalate chemical actinometric technique. The volumetric dose estimates obtained with the potassium ferrioxalate actinometer are converted to areal dose estimates by multiplying them by the irradiated volume to irradiated surface area ratio. Conservative estimates of dose are consistently achieved by assuming 100% reflectance of UV radiation off of reactor walls when approximating the irradiated surface area. Potassium ferrioxalate actinometry is found to provide reproducible dose estimates but is sensitive to procedural variation. The relatively high cost of potassium ferrioxalate actinometry combined with the difficulties associated with preparing and using the actinometer suggest that it is impractical for regular use in field situations. However, potassium ferrioxalate actinometry does appear to have the potential for being a useful tool in design evaluations and comparative studies of UV system efficiencies. (Author's abstract)
W87-09377

SURVIVAL AND MULTIPLICATION OF LEGIONELLA PNEUMOPHILA IN MUNICIPAL DRINKING WATER SYSTEMS,
City of Pittsburg Water Dept., Pittsburg, PA 15215.
S. J. States, L. F. Conley, J. M. Kuchta, B. M. Oleck, and M. J. Lipovich.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 5, p 979-986, May 1987. 4 tab, 42 ref. EPA Cooperative agreement CR80681-01-2.

Descriptors: *Legionella, *Drinking water, *Water treatment, *Residual chlorine, *Public health, Rivers, Disinfection, Chlorination, Diseases, Survival.

Studies were conducted to investigate the survival and multiplication of Legionella spp. in public drinking water supplies. An attempt was made, over a period of several years, to isolate legionellae from a municipal system. Sampling sites included the river water supply, treatment plant, finished water reservoir system, mains, and distribution taps. Despite the use of several isolation techniques, Legionella spp. could not be detected in any of the samples other than those collected from the river. It was hypothesized that this was due to the maintenance of a chlorine residual throughout this system. To investigate the potential for Legionella growth, additional water samples, collected from throughout the system, were dechlorinated, pasteurized, and inoculated with Legionella pneumophila. Subsequent growth indicated that many of these samples, especially those collected from areas affected by an accumulation of algal materials, exhibited a much greater ability to support Legionella multiplication than did river water prior to treatment. Chemical analyses were also performed on these samples. Correlation of chemical data and experimental growth results indicated that the chemical environment significantly affects the ability of the water to support multiplication, with turbidity, organic carbon, and certain metals being of particular importance. These studies indicate that the potential exist for Legionella growth within municipal systems and support the hypothesis that public water supplies may contaminate the plumbing systems of hospitals and other large buildings. The results also suggest that useful methods to control this contamination include adequate treatment plant filtration, maintenance of a chlorine residual throughout the treatment and distribution network, and effective covering of open reservoirs. (Author's abstract)
W87-09389

ANTIBIOTIC-RESISTANT PSEUDOMONAS IN BOTTLED DRINKING WATER,
Dept. of Biology, Northeastern Univ., 360 Huntington Avenue, Boston, MA, U.S.A. 02115.
H. H. Duquino, and F. A. Rosenberg.
Canadian Journal of Microbiology CJMIAZ, Vol. 33, No. 4, p 286-289, April 1987. 1 fig, 2 tab, 7 ref. Dept. of Health and Human Services Grant 07143.

Descriptors: *Bottled water, *Drinking water, *Pseudomonas, *Antibiotics, *Pollutant identifica-

tion, Isolation, Sensitivity, Resistance, Infections, Public health.

Eight different bottled drinking waters were tested weekly over an 8-month period to determine the diversity of their Pseudomonas population and their sensitivity to eight antibiotics used in treating Pseudomonas infections. Nine specie of Pseudomonas were recovered, with P. stutzeri (24%) and P. diminuta (18.8%) being the most common isolates. Sensitivity patterns of environmental and clinical isolates were shown to differ to some degree. Statistical analyses indicated a significant effect of specific antibiotic on the size of the inhibition zone, a significant difference between species and size of inhibition zone, and a strong species-antibiotic interaction. Distribution of species within the brands of water was also significantly different in 68% of the paired comparisons. (Author's abstract)
W87-09424

SCALE-UP OF WATER AND WASTEWATER TREATMENT PROCESSES.
Schmidtke (Norbert W.) and Associates Ltd., Kitchener (Ontario).
For primary bibliographic entry see Field 5D.
W87-09431

SCALE-UP AND SCALE-DOWN CONCEPTS AND PROBLEMS,
For primary bibliographic entry see Field 5D.
W87-09432

INTRODUCTION TO SCALE-UP OF WATER AND WASTEWATER TREATMENT PROCESSES,
Schmidtke (Norbert W.) and Associates Ltd., Kitchener (Ontario).
For primary bibliographic entry see Field 5D.
W87-09433

PERSPECTIVES ON THE SCALE-UP OF IMPELLER MIXERS,
Mixing Equipment Co., Rochester, NY.
For primary bibliographic entry see Field 5D.
W87-09434

IMPORTANT ISSUES IN THE SCALE UP OF NEW PROCESSES,
Commonwealth Scientific and Industrial Research Organization, Clayton (Australia). Div. of Chemical and Wood Technology.
For primary bibliographic entry see Field 5D.
W87-09435

FACTORS OF SCALE IN RAPID SAND FILTRATION,
Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering.
E. Davis.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 135-148, 1 fig, 1 tab, 48 ref.

Descriptors: *Water treatment, *Filtration, *Scale effect, *Design criteria, Engineering, Filter media, Mathematical models, Model studies, Particle size, Porosity.

Although filtration through sand or other granular material has been used and studied for 100 years, understanding of the process is insufficient to develop a mathematical model to predict filter performance. Laboratory filtration studies remain the key to filter design; however, scale factors must be considered in designing the full-scale process. In performing the laboratory tests, the actual raw water, temperature, and filter media must be used for relevant results. The scale factor is unity for laboratory filters to full-scale filters, except for diameter of the laboratory filter. With small-diameter filters containing coarse media, flow rate may become the governing factor. (See also W87-09431) (Cassar-PTT)
W87-09440

IMPORTANCE OF LABORATORY SCALE STUDY FOR THE DESIGN OF MOBILE-BED FILTER,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
S. Vigneswaran, W. I. Rabbani, and M. S. Naw.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 169-178, 6 fig, 3 tab, 5 ref.

Descriptors: *Water treatment, *Filtration, *Fluidized beds, *Sand filters, *Scale effect, *Design criteria, Sludge, Flocculation, Backwash, Filter media.

Filters with mobile-bed arrangement eliminate the problem of back washing and use the entire filter bed in efficient filtration action. The optimum values of operational parameters of mobile-bed filter (sand-recycling rate, sludge withdrawal rate, filter media specifications, filtration rate) can be evaluated from laboratory-scale experiments with the particular water to be treated. These values can be used to design a plant-scale mobile-bed filter in a rational manner. (See also W87-09431) (Author's abstract)
W87-09442

UNIQUE PRE-OZONATION - D.E. FILTRATION WATER TREATMENT PLANT DESIGN IS BASED ON PILOT PLANT DATA,
Pratt Inst., Brooklyn, NY.
C. Yapijakis.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 179-197, 10 fig, 5 tab, 14 ref, append.

Descriptors: *Water treatment, *Ozonation, *Scale effect, *Pilot plants, *Filtration, *Diatomaceous earth, *Design criteria, Oxidation, Turbidity, Iron, Manganese, Color removal, Trihalomethane precursors, Organic matter, Chlorinated hydrocarbons.

Pilot plant studies of two upland water supplies have been conducted in the New York City metropolitan area. These studies demonstrated that high quality water could be obtained from moderately colored, low turbidity water, using a process consisting of oxidation by ozonation followed by diatomite filtration. The process proved to be consistent and dependable under all conditions for reducing color to about 5 standard units or less and turbidity to less than 0.2 units, as well as removing iron and manganese. As compared to conventional treatment or direct filtration, the preozonation-diatomaceous earth process has the advantage of much lower first costs, less land requirement, and reduces significantly the production of chlorinated hydrocarbons in the treated water. Furthermore, this newly developed process lends itself superbly to fully automated operation both in the ozonation and in the diatomite filtration stage. Additional benefits come from the less cumbersome materials handling, the diatomaceous earth recovery possibility, and from the far better manageability of the wastewater and sludge of the process. (See also W87-09431) (Author's abstract)
W87-09443

DEVELOPMENT OF A NEW TYPE OF FLUIDIZED BED REACTOR,
Georgia Inst. of Tech., Atlanta.
For primary bibliographic entry see Field 5D.
W87-09444

MODELING FOR PROCESS SCALE-UP OF ADSORPTION AND ION EXCHANGE SYSTEMS,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W87-09446

SCALE-UP OF DIRECT FILTRATION (THE WAHNBACH SYSTEM),
Wahnbachtalsperrenverband, Siegburg (Germany, F.R.).
H. Bernhardt.
IN: Scale-Up of Water and Wastewater Treatment Processes, Butterworth, Boston, 1983. p 261-281, 9 fig, 5 tab, 23 ref.

Descriptors: *Water treatment, *Filtration, *Scale effect, *Design criteria, *Pilot plants, Wahnbach process, Phosphorous removal, Filter media, Energy, Chemical precipitation, Flocculation.

The Wahnbach phosphorous removal plant in the Federal Republic of Germany was designed after a 10-year accumulation of pilot plant data. The process, called energy-input controlled direct filtration, is a contact process which handles high turbidity surface waters using phosphorous precipitation with iron-III-salts and flocculation, followed by multimedia filtration at a high rate. Although scale-up from pilot plant to full-scale was successful, several factors responsible for adverse process behavior were first identified at the full-scale stage. These factors related to the size of the coagulation basin, associated energy input requirements, and the operation of the multimedia filters. (See also W87-09431) (Cassar-PTT)
W87-09447

SCALE-UP OF BIOLOGICAL WASTEWATER TREATMENT PROCESSES: PRACTICAL EXPERIENCES IN THE U.K.,
Water Research Centre, Stevenage (England).
For primary bibliographic entry see Field 5D.
W87-09453

5G. Water Quality Control

CLEAN WATER ACT UPDATE: A NEW ROLE FOR TOXICOLOGY,
Environmental Protection Agency, Washington, DC. Office of Analysis and Evaluation.
For primary bibliographic entry see Field 6E.
W87-08627

WHAT INDUSTRY IS DOING TO PROTECT AQUATIC LIFE,
Dow Chemical Company, Midland, MI. Mammalian and Environmental Toxicology.
H. C. Alexander, and J. A. Quick.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 37-44, 1 fig, 13 ref.

Descriptors: *Aquatic environment, *Water pollution control, *Water pollution effects, *Monitoring, *Industrial wastes, Ecosystems, Fate of pollutants, Environmental effects.

Much of the chemical industry has had long-term environmental involvement and commitment. The hazard evaluation process is being used by industry to evaluate its products, by-products, and waste for potential environmental effects. Fate and effects testing are the core of this process and provide the data for estimating hazards. The adverse environmental impact of wastes is minimized by recycling or reuse, chemical or biological treatment, high-temperature incineration, and secure landfilling. Biomonitoring and field surveys assess the environmental impact of effluents and product applications. Industry is concerned about the proper use, safe handling, and environmental impact from product use and disposal. (See also W87-08624) (Author's abstract)
W87-08628

WATER QUALITY CRITERIA: PROTECTION OF USE PERSPECTIVE,
Environmental Protection Agency, Washington, DC. Office of Water Regulations and Standards.
F. E. Gostomski.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 45-47, 7 ref.

Descriptors: *Water quality control, *Standards, *Regulations, Legislation, Water quality, Toxicity, Water analysis.

A water quality standard is a rule or law comprising of the use or uses to be made of a water body or segment and the water quality criteria necessary to protect that use or uses. States have primary responsibility for establishing appropriate uses of water bodies through a periodic review process involving consultation with the U.S. Environmental Protection Agency (EPA) and public hearings, which must occur at least once every three years. Where designated uses do not include those specified in the goals of the Clean Water Act (that is, fishable/swimmable), the state is required to conduct a use attainability analysis. The EPA has provided guidance for doing such an analysis. Criteria are elements of state water quality standards expressed as constituent concentrations or levels, or narrative statements, that represent a quality of water that supports a particular use. When criteria are properly selected and met, it is presumed that water quality will protect the designated use. The EPA is recommending that states develop site-specific criteria to reflect local conditions and has provided guidance for doing so. (See also W87-08624) (Author's abstract)
W87-08629

NEW APPROACH FOR REGULATING IRON IN WATER QUALITY STANDARDS,
American Electric Power Service Corp., Columbus, OH. Environmental Engineering Div.
P. H. Loeffelman, J. H. V. Hassel, T. E. Arnold, and J. C. Hendricks.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 137-152, 1 fig, 34 ref.

Descriptors: *Water pollution effects, *Water quality control, *Regulations, *Standards, *Iron, *West Virginia, Toxicity, Fish, Water quality, Chemical analysis, Bathophenanthroline.

During the review of water quality standards by the West Virginia Water Resources Board in 1983, the American Electric Power Company (AEP) prepared comments regarding the U.S. Environmental Protection Agency (EPA) and state total iron limit of 1.0 mg/L. AEP argued that: (1) field evidence indicated that aquatic biota can maintain viable communities at concentrations well in excess of 1.0-mg iron/L in many water bodies; (2) agency monitoring data showed ambient total iron concentrations frequently in excess of the limit to be closely correlated with stream flow and suspended solids without apparent harm to aquatic life; (3) most laboratory toxicity data for iron were not appropriate to derive an iron limit because of questionable analytical or toxicity testing procedures; and (4) consistent with U.S. EPA-proposed water quality criteria based upon biologically available forms of metals, ferrous iron and not total iron should be limited for most freshwater bodies. These AEP studies, an analytical procedure modified for directly measuring ferrous iron with the reagent bathophenanthroline (BPA), and the rationale for regulating BPA-reactive ferrous iron, not total iron, in most water bodies, are described. The AEP conducted studies of iron chemistry in natural waters, and toxicity tests were conducted to determine whether the toxic effects on warmwater organisms could be better related to total iron to an iron fraction, such as ferrous iron, whether these fractions could be simply, inexpensively, and accurately measured, and whether measurable concentrations of these forms could be found in natural waters. (See also W87-08624) (Lantz-PTT)
W87-08636

EFFECT OF UPLAND PASTURE IMPROVEMENT ON NUTRIENT RELEASE IN FLOWS FROM A 'NATURAL' LYSIMETER AND A FIELD DRAIN,
Institute of Hydrology, Wallingford (England).
G. Roberts, J. A. Hudson, and J. R. Blackie.
Agricultural Water Management AWMADF, Vol. 11, No. 3/4, p 231-245, September 1986. 3 fig, 2 tab, 33 ref.

Descriptors: *Water pollution sources, *Nonpoint sources, *Water quality control, *Leaching, *Nutrients, *Drainage, *Land management, *Pastures, *Lysimeters, *Drain flow, Fertilizers, Tillage, Water quality.

The effect of upland pasture improvement on nutrient losses was assessed by comparing lysimeter and drain flows from two peat over clay areas before, during and following a lime application, disc harrowing, a fertilizer application and reseeding one of the areas. Rates of fertilizer application were 125 kg/ha of N, 256 kg/ha of P2O5 and 65 kg/ha of K2O. Enhanced nitrogen, specifically nitrate-N concentrations, with peak values of the order of 18 mg/l, were observed in both the subsurface flow from the lysimeter and in the field drain for some months following improvement. These enhanced concentrations were attributed to the tillage operations as opposed to the fertilizer applications. No significant increases in potassium or phosphorus concentrations were observed. The results suggest that the gradual improvement of upland areas will not cause a serious water quality problem. (Author's abstract)
W87-08741

IMPROVEMENT OF IRRIGATION WATER BY GYPSUM BEDS,
Haryana Agricultural Univ., Hisar (India). Dept. of Soils.
M. Singh, S. R. Poonia, and R. Pal.
Agricultural Water Management AWMADF, Vol. 11, No. 3/4, p 293-301, September 1986. 3 fig, 7 tab, 3 ref.

Descriptors: *Saline water, *Water treatment, *Water chemistry, *Irrigation water, *Gypsum beds, *Water quality, Flow velocity, Dissolution, Carbonates.

An in situ experiment was conducted on a newly designed gypsum bed in a water course to ascertain the dissolution of gypsum in relation to water flow velocities, gypsum fragment sizes and water quality. A decrease in flow velocity increased gypsum dissolution for all fragment sizes. At a given flow velocity, dissolution of gypsum increased with decrease in fragment size. The presence of Ca(2+) or SO4(2-) in irrigation water suppressed the dissolution of gypsum, whereas an increase in electrolyte concentration of irrigation water free from common ions enhanced it. The residual sodium carbonate (RSC) waters containing HCO3(-) did not decrease gypsum dissolution due to a CaCO3 coating on the gypsum fragments. Empirical factors were obtained to calculate the effect of electrolyte concentration and RSC on gypsum dissolution. There was good agreement between the experimental and the calculated bed heights for different gypsum fragment sizes and water flow velocities. (Author's abstract)
W87-08745

HYDRAULIC/CHEMICAL CHANGES DURING GROUND-WATER RECHARGE BY INJECTION,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W87-08751

WATER-QUALITY TRENDS IN THE NATION'S RIVERS,
Geological Survey, Reston, VA.
R. A. Smith, R. B. Alexander, and M. G. Wolman.
Science SCIEAS, Vol. 235, No. 4796, p 1607-1615, March 1987. 5 fig, 3 tab, 62 ref.

Descriptors: *Water quality, *Rivers, Bacteria, Feces, Lead, Nitrates, Chlorides, Arsenic, Cadmium, Regional variation.

Water-quality records from two nationwide sampling networks now permit nationally consistent analysis of long-term water-quality trends at more than 300 locations on major U.S. rivers. Observed trends in 24 measures of water quality for the period from 1974 to 1981 provide new insight into changes in stream quality that occurred during a time of major changes in both terrestrial and atmospheric influences on surface waters. Particularly noteworthy are widespread decreases in fecal bacteria and lead concentrations and widespread increases in nitrate, chloride, arsenic, and cadmium concentrations. Recorded increases in municipal waste treatment, use of salt on highways, and nitrogen fertilizer application, along with decreases in leaded gasoline consumption and regionally variable trends in coal production and combustion during the period appear to be reflected in water-quality changes. (Author's abstract)
W87-08779

VELOCITY CONTROL AS A TOOL FOR OPTIMAL PLUME CONTAINMENT IN THE EQUUS BEDS AQUIFER, KANSAS,
Kansas State Geological Survey, Lawrence.
M. Heidari, J. Sadeghipour, and O. Drici.
Water Resources Bulletin WARBAQ, Vol. 23, No. 2, p 325-335, April 1987. 8 fig, 26 ref. EPA Cooperative agreement S007249-01.

Descriptors: *Water quality control, *Water pollution control, *Groundwater pollution, *Groundwater pollution, *Model studies, *Plumes, *Path of pollutants, Equus Beds aquifer, Kansas, Monitoring wells, Velocity, Wells, Migration, Solute transport, Economic aspects.

A groundwater-management model was developed to investigate the best management options for the containment of an oil-field-brine plume in the Equus Beds aquifer in south-central Kansas. The main purpose of the management model was to find the optimal locations and minimum rates of pumpage of a set of plume-interception wells, to successfully reverse the velocity vectors at observation wells located along the plume front, and also to satisfy freshwater demands from supply wells. The effects of the calculated minimum withdrawals from the interception wells on the migration of contaminants throughout the groundwater system were evaluated utilizing a solute-transport model. This latter analysis was carried out to ensure the containment of the plume. Whereas application of the management model to the study area achieves the management objectives, the implementation of the results is believed to be impractical and expensive. This is because a considerable amount of water must be pumped out to reverse the velocity vectors in the vicinity of the plume. In general, the proposed technique of pollutant containment may be effective when applied to aquifers having low hydraulic gradients and/or to aquifers with hazardous plumes whose containment is not subject to economic constraints. (Author's abstract)
W87-08982

MULTIATTRIBUTE ANALYSIS OF THE IMPACT ON SOCIETY OF PHOSPHORUS ABATEMENT MEASURES,
Center for Industrial Research, Oslo (Norway).
K. L. Seip, H. Ibrekk, and F. Wenstop.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 755-764, May 1987. 4 fig, 3 tab, 36 ref, 3 append.

Descriptors: *Multiattribute analysis, *Pollution control, *Phosphorus, *Lakes, *Water quality control, *Environmental effects, Norway, Agriculture, Wastewater treatment, Social impact.

A decision goal hierarchy evaluates the impact and cost to society of phosphorus abatement measures to improve lake water quality. Three primary measures were studied: sewage treatment, ban of detergents containing phosphorus, and changes in agricultural practice, and combinations of these measures. The water system studied is lakes in Norway represented by eight typical water bodies. The results showed that the highest utility was obtained by 'status quo' (0.90 + or - 0.02) and implementing measures in agriculture (0.90 + or - 0.02). The combined measures including sewage treatment and ban on phosphorus containing detergents scored lowest (0.73 + or - 0.08). (Author's abstract)
W87-09013

RESTORATION OF THE RIVER VAIKKOJOKI, FINLAND,

Kuopio Univ. (Finland). Dept. of Applied Zoology.
For primary bibliographic entry see Field 2H.
W87-09046

DEVELOPMENT OF A SIMPLIFIED COLUMN TEST FOR EVALUATION OF THICKNESS OF CAPPING MATERIAL REQUIRED TO ISOLATE CONTAMINATED DREDGED MATERIAL,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
D. Gunnison, J. M. Brannon, T. C. Sturgis, and I. Smith.
Miscellaneous Paper D-87-2, March 1987. Final Report. 34 p, 2 fig, 7 tab, 12 ref.

Descriptors: *Water quality control, *Waste disposal, *Dredging, *Capping, *Materials testing, Leaching, Ammonium, Nitrogen, Phosphates, Manganese, Benthic organisms, Water column.

A procedure using a small-scale (22.6 L) leaching column was developed for predicting the cap thickness required to chemically seal contaminated dredged sediment from the overlying water column. Several parameters, including dissolved oxygen depletion rates and release rates of ammonium-nitrogen, orthophosphate-phosphorus, and manganese, were evaluated as tracers for use in the predictive test. In addition, several tests were run using potassium chloride amendments to the contaminated sediment prior to capping to determine if this salt would be a suitable tracer. Dissolved oxygen depletion and ammonium-nitrogen release were generally the best tracers to use for predictive purposes. On occasion, orthophosphate-phosphorus release was also an effective tracer. Use of manganese or potassium chloride as tracers proved ineffective. Overall, the verification tests indicated that the small-scale predictive tests provided the information required to determine the cap thickness necessary to obtain a satisfactory chemical seal; however, it was apparent that additional cap material was necessary to obtain the most effective seal against biological activity. It is important that the cap thickness selected with the small-scale tests be shown to seal a minimum of two of the three parameters used to measure cap effectiveness. To prevent exposure of burrowing benthic organisms to contaminated sediment, it is recommended that a safety margin be added to the thickness required to achieve a chemical seal. This safety margin is determined by the depth to which the deepest burrowing benthic organism within the region can reach. The sum of the thickness required to achieve the safety margin and the thickness required for the chemical seal is the thickness necessary to isolate the contaminated sediment chemically and biologically from the overlying water column and the aquatic biota. This work does not include hydrodynamic effects that may result in resuspension and/or scouring of cap material. Procedures to counter the effects of hydrodynamic processes require engineering considerations that will be addressed in later guidance. (See also W87-09067) (Lantz-PTT)
W87-09091

PHOTOLYTIC OZONATION FOR PROTECTION AND REHABILITATION OF GROUNDWATER RESOURCES; A MECHANISTIC STUDY,
Illinois State Water Survey, Champaign. Aquatic Chemistry Section.
G. R. Peyton, M. A. Smith, and B. M. Peyton.
Research Report 206, UILU-WRC-87-206, January 1987. 58 p, 18 fig, 5 tab, 46 ref. Water Resources Center Project No. S-104-ILL.

Descriptors: *Model studies, *Water pollution treatment, *Photolytic ozonation, *Groundwater quality, *Water quality control, Organic compounds, Ozonation, Cleanup operations, Chemical reactions.

The cleanup of groundwater resources which have been contaminated by anthropogenic organic compounds is difficult and expensive. Furthermore, most treatment methods merely transfer the contaminant to another phase, such as an adsorbant or the atmosphere. A treatment process which produces harmless by-products, could be set up on site, and does not require the transport of hazardous materials is very desirable for such cleanup operations. Photolytic ozonation, the combination of ozone treatment and ultraviolet irradiation, is an oxidative water treatment process which is capable of converting virtually any organic pollutant completely to carbon dioxide and water. Thus, it is potentially a very 'clean' solution to many contamination problems. There has, however, been disagreement in the scientific literature concerning the effectiveness of the process, due largely to a lack of understanding of the chemistry which is involved. In this project, photolytic ozonation was studied at the laboratory scale, to better understand and, if possible, model the complex chemical reaction mechanism, so that the process can be more easily optimized from an economic standpoint. It was shown that hydroxyl radical, the active species responsible for the destruction of organic pollutants, is not generated directly by ozone photolysis as has generally been speculated, but is produced by secondary reactions. A model has been developed which explains the behavior of the process under a variety of conditions and is useful for the prediction of process performance. The model includes parameters, the values of which may be inferred from the chemical structure of the organic pollutant. The reaction system is seen to be 'versatile' in that it has alternate pathways by which pollutant destruction may proceed, depending on conditions in the water being treated. (See also W87-09067) (Author's abstract)
W87-09092

DETERMINING OPTIMUM PUMPING RATES FOR CREATION OF HYDRAULIC BARRIERS TO GROUND-WATER POLLUTANT MIGRATION,
Battelle Pacific Northwest Labs., Richland, WA.
J. M. Shafer.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as DE84-013245. Price codes: A03 in paper copy, A01 in microfiche. Report No. PNL-SA-11828, April 1984. 47 p, 10 fig, 5 tab, 17 ref. NRC Contract No. DE-AC06-76RLO 1830.

Descriptors: *Model studies, *Groundwater pollution, *Path of pollutants, *Groundwater movement, *Water pollution prevention, *Hydraulic models, *Algorithms, Mathematical models, Groundwater management, Pumping, Groundwater recharge, Wells, Mathematical studies, Water quality control.

In certain groundwater flow regimes control of the migration of pollutants can be achieved by hydraulic barriers created by groundwater withdrawal and/or injection. However, for complicated flow domains and situations where multiple wells may be installed, the determination of pumping rates to achieve a pollution control objective can be difficult. A nonlinear programming (NLP) algorithm is coupled to a two-dimensional, steady-state, groundwater flow model and an advective transport model for determination of optimum pumping rates for creation of hydraulic barriers. This technique is a screening tool for the selection of pumping rates to be subsequently confirmed with more detailed simulation. Utilization of this technique can save time and cost over traditional trial and error methods of determining pumping rates. Two example applications of this technique are presented. The first example shows how NLP can be used to determine pumping rates required to develop a stagnation point. Optimum pumping rates for eight wells arranged in a circular configuration are determined so as to reduce the groundwater velocity to near zero over a precise region within a nonhomogeneous aquifer. The second example involves the determination of optimum steady-state pumping rates for six wells in a nonhomogeneous flow domain where the objective is the control (i.e., steering) of the trajectory of a contaminant plume. (Author's abstract)
W87-09108

OCCURENCE OF CONTAMINATION IN DRINKING WATER FROM GROUNDWATER SOURCES,
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
For primary bibliographic entry see Field 5B.
W87-09125

IMPROVED MONITORING TECHNIQUES TO ASSESS GROUNDWATER QUALITY NEAR SOURCES OF CONTAMINATION,
Environmental Monitoring Systems Lab., Las Vegas, NV.
For primary bibliographic entry see Field 5A.
W87-09126

REGULATION OF CONTAMINANTS IN DRINKING WATER,
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
For primary bibliographic entry see Field 5F.
W87-09128

FEDERAL PROTECTION OF GROUNDWATER,
Kadison, Pfaelzer, Woodward, Quinn, and Rossi, Washington, DC.
T. L. Harker.
IN: Safe Drinking Water: The Impact of Chemicals on a Limited Resource. Lewis Publishers, Chelsea, Michigan. 1985. p 197-200.

Descriptors: *Groundwater pollution, *Water pollution prevention, *Water quality control, *Drinking water, *Water law, Groundwater management, Water pollution control, Water quality standards, Regulations, Environmental protection, Pesticides, Federal jurisdiction.

A groundwater protection strategy at the federal level must account for the potential conflict between those who may abuse groundwater. A federal groundwater protection strategy must also determine not only the significant sources of groundwater, but the significant sources of impact on groundwater and establish priorities accordingly. The Comprehensive Environmental Response, Compensation and Liability Act is aimed at cleaning up thousands of abandoned hazardous waste disposal sites. Response actions taken by states and EPA at such sites frequently involve very costly groundwater monitoring and remedial engineering methods. Under the Resource Conservation and Recovery act EPA has adopted hazardous waste and solid waste disposal regulations that are aimed at groundwater protection. Under the Safe Drinking Water Act, EPA protects groundwater through Underground Injection Control regulations and through sole source aquifer protection. The EPA may take account of the relationship between surface and groundwater in granting permits under the NPDES portion of the Clean Water Act. Other federal statutes which have less bearing on groundwater protection include the Federal Surface Mining Control and Reclamation Act, the Toxic Substances Control Act, and the Federal Insecticide, Fungicide, and Rodenticide Act. With the exception of the Superfund Act and UIC program under the Safe Drinking Water Act, none of these federal statutes is directed primarily at groundwater protection. Critics of the current federal approach to groundwater protection have called for a comprehensive program based on nondegradation of groundwater, the adoption of groundwater quality standards and effluent limitation, and the implementation of land use controls aimed at protecting recharge zones. (See also W87-09114) (Geiger-PTT)
W87-09129

WORLD HEALTH ORGANIZATION AND GUIDELINES AND EUROPEAN ECONOMIC COMMUNITY DIRECTIVES,
Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
For primary bibliographic entry see Field 6E.
W87-09130

REGULATORY FLEXIBILITY AND CONSUMER OPTIONS UNDER THE SAFE DRINKING WATER ACT,

Kadison, Pfaelzer, Woodward, Quinn, and Rossi, Washington, DC.
For primary bibliographic entry see Field 5F.
W87-09131

CONGRESSIONAL INITIATIVES,
Senate, Washington, DC.
R. T. Stafford.
IN: Safe Drinking Water: The Impact of Chemicals on a Limited Resource. Lewis Publishers, Chelsea, Michigan. 1985. p 255-261.

Descriptors: *Water quality control, *Groundwater management, *Groundwater recharge, *Drinking water, *Water quality management, Water supply, Water law, Groundwater pollution, Aquifers, Wells, Hazardous materials, Injection wells, Underground waste disposal.

Even though the United States is groundwater rich, many parts of the country face severe shortages of groundwater as a drinking water source due to overuse or contamination of the supply. The amount of hazardous wastes injected into wells is bound to increase as federal and state regulation of landfills, surface impoundments and incinerators get tougher. EPA estimated that, in 1978, between five thousand and ten thousand injection wells occurred above aquifers. That estimate has been dropping steadily since then. It is often difficult for some cities and towns to finance construction of water treatment facilities needed to comply with drinking water standards. Congress has responded to this concern by allowing states to grant case-by-case extensions of up to three years to meet interim primary standards. Officials in the state of Iowa have decided that, because of reduced federal support, the state no longer can afford to continue the primary enforcement authority for the drinking water program. A recent study by the General Accounting Office reported widespread noncompliance by local water systems with federal drinking water standards. This was attributed to insufficient resources at the state and local levels and inadequate guidance from the federal level. (See also W87-09114) (Geiger-PTT)
W87-09133

GROUND WATER POLLUTION CONTROL,
Oklahoma Univ., Norman. Environmental and Ground Water Inst.
L. W. Canter, and R. C. Knox.
Lewis Publishers, Inc., Chelsea, MI. 1985. 526 p.

Descriptors: *Groundwater quality, *Water quality control, *Water pollution prevention, *Water pollution treatment, *Aquifers, Biological treatment, Chemical treatment, Standards, Regulations.

As a result of the growing recognition of groundwater pollution problems, there is a growing interest in, and implementation of, groundwater pollution control programs. These programs are an outgrowth of: (1) the federal 'Superfund' program administered by the U.S. Environmental Protection Agency (EPA); (2) the Installation Restoration Program administered by the Department of Defense; (3) the increasing number of state-level 'Superfund' programs; (4) public pressures to clean up accidental spills and leakage from underground storage tanks; and (5) the expanding knowledge base on technical alternatives which are potentially available for usage in these programs. This book has been written to summarize the state-of-knowledge on technical alternatives available for usage in groundwater pollution control programs, and to delineate decision-making techniques which can be used in the selection process for these alternatives. The book is organized into three major headings: Technologies; Decision-Making; and Case Studies and Applications. Following an introductory chapter, three categories of technologies are addressed: physical control measures in Chapter 2, treatment of groundwater in Chapter 3, and in situ chemical and biological measures in Chapter 4. Chapter 2 includes information on source control strategies, stabilization/solidification methods, well systems, interceptor systems, capping and liners, sheet piling, grouting and slurry walls. Treatment of groundwater via air stripping, carbon adsorption, biological treatment, chemical precipitation, and other treatment techniques is summarized in Chapter 3. Chapter 4 summarizes the advantages and disadvantages of in situ chemical treatment, and presents extensive information on in situ biological stabilization via enhancement of the indigenous microbial population or addition of acclimated microorganisms. Decision-making is addressed in Chapters 5 through 8. Chapter 5 presents a protocol for aquifer restoration decision-making and includes a summary of preliminary study activities and the development and evaluation of alternatives. An extensive summary of techniques for decision-making is in Chapter 6. Chapter 7 addresses risk assessment as related to aquifer restoration planning and includes summaries of two methods applicable to hazardous waste disposal sites. Chapter 8 focuses on public participation and highlights approaches for identifying publics and selecting public participation techniques. (Lantz-PTT)
W87-09150

GROUNDWATER MANAGEMENT IN FRANCE,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
For primary bibliographic entry see Field 2F.
W87-09205

NONPOINT AGRICULTURAL POLLUTION: PESTICIDE CONTAMINATION OF GROUNDWATER SUPPLIES,
Rhode Island Univ., Kingston. Dept. of Resource Economics.
For primary bibliographic entry see Field 5B.
W87-09213

WATER TREATMENT: THE STATES ZERO IN ON GROUNDWATER REGULATION,
For primary bibliographic entry see Field 5F.
W87-09222

SUPPRESSION OF PHOSPHATE LIBERATION FROM SEDIMENT BY USING IRON SLAG,
Tokai Regional Fisheries Research Lab., the Ministry of Agriculture, Forestry and Fisheries, Arasaki, Nagai, Yokosuka 238-03.
H. Yamada, M. Kayama, K. Saito, and M. Hara.
Water Research WATRAG, Vol. 21, No. 3, p 325-333, March 1987. 8 fig, 4 tab, 27 ref.

Descriptors: *Water pollution prevention, *Water pollution treatment, *Phosphorus, *Cycling nutrients, *Seawater, *Phosphates, *Sediments, *Iron slag, Sulfides, Adsorption.

In order to suppress the phosphate liberation from sediment to sea water, several suppressing materials such as four kinds of iron slag, river and sea sands, and glass bead were tested. The sediment and sea water were sampled from Hiroshima Bay which seemed to be a eutrophicated area. The suppressing materials were covered on the surface of sediment, and sea water was introduced in the aquarium. The concentrations of phosphate, sulfide and dissolved oxygen were measured during the incubation period under the condition of anaerobic state. The suppressing effects of slags, sea and river sands were compared with that of glass bead used as control materials, and the suppression efficiencies were measured. The suppression efficiency of glass bead was 54.1%, and those of slag-2, -3 and -4 were 97.3, 96.1 and 98.8%, respectively. The suppression efficiency depended on the amounts of slag used, and about 85% of liberated phosphate were suppressed by slag-3 of 7.5 kg/sq m. The sulfide ion generated under anaerobic state reacted with some metals on the surface of slags and sands, and the dissolution of precipitated phosphate (Fe-P, Al-P and Ca-P) was suppressed by formation of metal sulfide on the surface of slags and sands. The suppression mechanisms on phosphate liberation, such as covering, chemical and adsorption effects were proposed and discussed. The suppression by slag was mainly carried out by the adsorption effect, in addition to the covering effect. (Author's abstract)
W87-09273

ENVIRONMENTAL LEGISLATION,
Springborn Bionomics, Inc., Wareham, MA. Aquatic Toxicology Lab.
For primary bibliographic entry see Field 6E.
W87-09299

INSTRUMENTATION FOR ENVIRONMENTAL MONITORING, VOLUME 2: WATER,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5A.
W87-09303

ECOLOGICAL FACTORS IN THE SELECTION OF REPRESENTATIVE SPECIES FOR THERMAL EFFLUENT DEMONSTRATIONS,
WAPORA, Inc., Chevy Chase, MD.
For primary bibliographic entry see Field 5C.
W87-09315

ANNUAL MACROINVERTEBRATE SAMPLING - A LOW-COST TOOL FOR ECOLOGICAL ASSESSMENT OF EFFLUENT IMPACT,
Institute of Paper Chemistry, Appleton, WI.
For primary bibliographic entry see Field 5C.
W87-09325

PETROLEUM SPILLS IN THE MARINE ENVIRONMENT: THE CHEMISTRY AND FORMATION OF WATER-IN-OIL EMULSIONS AND TAR BALLS,
Science Applications International Corp, La Jolla CA. Div. of Applied Environmental Sciences.
For primary bibliographic entry see Field 5B.
W87-09339

DEPENDENCE OF RIVER POLLUTION ON STREAMFLOW REGULATION BY RESERVOIRS,
I. V. Gordin.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 7, p 426-429, July 1986. 1 fig, 1 tab, 9 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 33-35, July 1986.

Descriptors: *Water pollution control, *Rivers, *Reservoirs, *Reservoir operation, *Water quality management, Streamflow, USSR.

As technogenic pollution of the natural hydrosphere increases, ever greater attention is being attracted to the problems of regulating fluctuations of water quality to improve the conditions of water use. This report discusses the evaluation and control of water quality which continually varies with time. It is shown that regulation of streamflow with a reservoir reduces average pollution concentration. The arguments are supported with data from the Krapiva Reservoir on the Tom river. (Ram-PTT)
W87-09361

METAL PRECIPITATION IN TWO LANDFILL LEACHATES,
Michigan Univ., Ann Arbor.
H. V. Mott, K. E. Hartz, and D. R. Yonge.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 3, p 476-485, June 1987. 1 fig, 11 tab, 22 ref.

Descriptors: *Water pollution treatment, *Water pollution control, *Leachate, *Landfills, *Path of pollutants, *Groundwater pollution, *Heavy metals, *precipitates, Sorption, Washington, Speciation.

Leachate from solid-waste landfills poses a significant environmental threat to groundwater supplies, warranting capture and treatment. Treatment prior to biological co-production to reduce heavy metal concentrations via sorption onto in situ precipitated hydrous ferric and manganese oxides may provide adequate reductions while minimizing hazardous residuals. This investigation studied the partitioning of cadmium, copper, zinc, and nickel with iron and manganese solid phase formed from leachate constituents at pH 9. Batch-type partitioning

experiments were conducted using sodium hydroxide and calcium hydroxide for pH control. Naturally produced leachate was obtained from the Snohomish County and King County solid-state disposal facilities in Washington state. The cadmium-sorbent ratios of this investigation were well below those found by previous researchers; however, removal rates were somewhat below those found in organic-free systems. These lower removal rates might be attributed to the 'complexation' of cadmium by leachate organic constituents. Copper-sorbent ratios were also well below those found by previous researchers; conversely, removal rates were significantly below those found for organic-free systems. Lower copper removal rates could be attributed to the complexation by organics and the formation of uncharged and negatively charged species at pH 9. Zinc-sorbent ratios were much higher than those found by previous researchers; however, removal rates were similar. The mechanism of zinc partitioning was probably the formation of a zinc oxide solid phase. Nickel-sorbent ratios were well below those of organic-free systems. Lower nickel removal rates cannot be attributed to either organic complex formation or speciation effects. (Author's abstract)
W87-09368

EVALUATING ASPHALT CAP EFFECTIVENESS AT SUPERFUND SITE,
Solid Wastes Disposal Program; National Solid Wastes Management Association, Washington, DC 20036.
For primary bibliographic entry see Field 5E.
W87-09379

INDUCTION OF SIDEROPHORE ACTIVITY IN ANABAENA SPP. AND ITS MODERATION OF COPPER TOXICITY,
Dept. of Chemistry, Portland State Univ., Portland, OR 97207.
S. E. Clarke, J. Stuart, and J. Sanders-Loehr.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 5, p 917-922, May 1987. 5 fig, 1 tab, 44 ref. PHSNIH GM 18865.

Descriptors: *Algicides, *Anabaena, *Water pollution effects, *Copper, *Toxicity, *Siderophores, Schizokinen, Algae, Cultures, Iron, Heavy metals, Growth.

Growth of Anabaena sp. strain 7120 (in the absence of chelators or added iron) was inhibited by the addition of 2.1 to 6.5 micromolar copper and was abolished by copper concentrations of 10 micromolar or higher. When the copper was chelated to schizokinen (the siderophore produced by this organism in response to iron starvation), the toxic effects were eliminated. Analysis of culture filtrates showed that the cupric schizokinen remains in the medium, thereby lowering the amount of copper taken up by the cells. Although this organism actively transports ferric schizokinen, it apparently does not recognize the cupric complex. Thus, Anabaena sp. is protected from copper toxicity under conditions in which siderophore is being produced. For cells grown in low iron, the accumulation of extracellular schizokinen was observed to parallel cell growth and continue well into stationary phase. The actual iron status of the organism was monitored by using iron uptake velocity as an assay. Cultures grown on 0.1 micromolar added iron were found to be severely iron limited upon reaching stationary phase, thus explaining the continued production of schizokinen. These data show that the siderophore system in Anabaena spp. has developed primarily as a response to iron starvation and that additional functions such as alleviation of copper toxicity or allelopathic inhibition of other algal species are merely secondary benefits. (Author's abstract)
W87-09386

MAINTENANCE AND STABILITY OF INTRODUCED GENOTYPES IN GROUNDWATER AQUIFER MATERIAL,
Tennessee Univ., Knoxville. Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W87-09391

MEASUREMENT OF WATER POTENTIAL IN LOW-LEVEL WASTE MANAGEMENT,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 7B.
W87-09456

INFLUENCE OF MELTWATER ON THE AMOUNT AND COMPOSITION OF GROUNDWATER IN QUATERNARY DEPOSITS IN FINLAND,
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 2F.
W87-09460

WATER QUALITY ASSESSMENT: A SCREENING PROCEDURE FOR TOXIC AND CONVENTIONAL POLLUTANTS, PART I,
Tetra Tech, Inc., Lafayette, CA.
For primary bibliographic entry see Field 5B.
W87-09462

INVESTIGATION AND DISCUSSION OF TECHNIQUES FOR HYPOLIMNION AERATION/OXYGENATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
J. P. Holland, and C. H. Tate.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report E-84-10, October 1984. Final Report. 53 p, 8 fig, 38 ref, append.

Descriptors: *Reservoirs, *Lakes, *Hypolimnion, *Aeration, *Oxygenation, *Water quality control, Clarks Hill Reservoir, Richard B. Russell Reservior, Water quality, Diffusers, Dissolved oxygen, Model studies, South Carolina, Georgia.

This report examines elements of the design and operation of hypolimnetic aeration systems. Three basic types of hypolimnetic aerators are identified, and pertinent literature for each is reviewed. Hypolimnetic aeration with pure oxygen at Clarks Hill Reservior, Georgia-South Carolina, is overviewed. Included are results of hypolimnetic aeration field tests conducted by contractors and the U.S. Army Corps of Engineers at Clarks Hill. Results from these tests showed that, for hypolimnetic oxygenation to most effectively enhance downstream release, most of the input oxygen should be placed (1) within the hypolimnetic withdrawal zone and (2) by a linear diffuser. A number of hypolimnetic aerator designs are considered. The use of numerical simulation techniques to predict idealized values for aerator design is also discussed. A combination of such results from the Clarks Hill field tests and numerical simulation efforts has produced the initial design for a hypolimnetic oxygenation system at Richard B. Russell Reservior, South Carolina-Georgia, which is presented. (Author's abstract)
W87-09481

PROCEEDINGS: 1981 OIL SPILL CONFERENCE (PREVENTION, BEHAVIOR, CONTROL, CLEANUP).
American Petroleum Inst., Washington, DC.
For primary bibliographic entry see Field 5B.
W87-09507

EVALUATION OF OIL SPILL DISPERSANT TESTING REQUIREMENTS,
SRI International, Menlo Park, CA.
R. T. Rewick, K. A. Sabo, J. Gates, J. H. Smith, and L. T. McCarthy.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlantic, GA. p 5-10, 3 fig, 4 tab, 10 ref.

Descriptors: *Cleanup operations, *Dispersants, *Oil spills, Chemical treatment, Chemical coagulation, Flocculation, Performance evaluation, Surfactants.

We have evaluated a number of laboratory tests of dispersant effectiveness using commercial oil spill products and No. 2 and No. 6 fuel oils. The tests-the EPA, Mackay/Steelman, Russian, French, Warren Spring and an interfacial tension method developed at SRI-are reviewed in terms of type, scale, method of applying mixing energy, and the time required to conduct a project evaluation. The experimental results, compared in terms of the precision of the test data and the effectiveness ranking order of the six nonionic dispersants, demonstrate that the relative effectiveness found for the dispersants varies appreciably as a function of the testing method. Reasons for the variations are discussed and recommendations are presented on how to achieve dispersant testing data that are more representative of real-world conditions. Of the six testing methods evaluated, the EPA, Mackay/Steelman, and the interfacial tension methods are the most amendable improvement. (See also W87-09507) (Author-abstract)
W87-09508

LABORATORY DETERMINATION OF DISPERSANT EFFECTIVENESS: METHOD DEVELOPMENT AND RESULTS,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
D. Mackay, and F. Szeto.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 11-17, 2 fig, 2 tab, 15 ref.

Descriptors: *Oil spills, *Dispersants, *Flocculation, *Oil, *Performance evaluation, Chemical coagulation, Chemical treatment, Surfactants.

A research project is described in which a previously described effectiveness test for chemical oil spill dispersants was further developed and standardized. The principle of the test is that known volumes of dispersant and crude oil are contacted on the surface of seawater in a laboratory-scale vessel in which there is a circulating air current that imparts a swirling wave action to the water. This flow geometry is believed to simulate ocean surface conditions better than tests that involve shaking, stirring, or pumping as turbulence-generating mechanisms. From the results of a series of tests at various dispersant-to-oil ratios, the ratios that affect the dispersion of 50 and 75% of the original amount of oil added to the water surface are calculated and used as an indication of dispersant effectiveness. The corresponding percent of the oil that remains deispersed after settling is also deduced. The results of a series of tests using two crude oils, Murban (light) and La Rosa (heavy), and 17 dispersants are presented. These results show a wide range in the dispersant-to-oil ratio necessary to achieve 50- to 75% dispersion. Five products failed to achieve 50% dispersion of both crude oils at a dispersant-to-oil ratio of 0.2, which is highly regarded as the practical upper limit of dispersant dosage. There was a group of highly effective dispersants requiring a dispersant-to-oil ratio of only 0.005 to 0.007 to accomplish 50% dispersion. The test method can discriminate between two dispersant products with effectivenesses which differ by approximately 10%. The implications of these experimental results are discussed. (See also W87-09507) (Author's abstract)
W87-09509

VIEW OF THE LABORATORY TESTING AND ASSESSMENT OF OIL SPILL DISPERSANT EFFICIENCY,
British Petroleum Co. Ltd., Sunbury-on-Thames (England).
D. G. Meeks.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 19-29, 1 tab, 22 ref, append.

Descriptors: *Dispersants, *Oil spills, *Performance evaluation, Surfactants, Oil, Chemical treatment, Cleanup operations.

This paper outlines the role of a dispersant in an oil spill plan and sets out criteria by which the product should be judged in terms of its dispersing efficiency and biodegradation. It reviews the mixing needed in a laboratory test relative to conditions associated with dispersant use at sea. An ideal set of requirements for a laboratory test and ways of assessment are discussed, stressing the

importance of confirmation of these results by sea testing. After reviewing currently used tests, the test favored by BP is described. Ideas are expressed for future efficiency-rating improvements. (Author's abstract)
W87-09510

USE OF DISPERSANTS ON VISCOUS FUEL OILS AND WATER IN CRUDE OIL EMULSIONS,
Warren Spring Lab., Stevenage (England).
M. Lee, F. Matinelli, B. Lynch, and P. R. Morris.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 31-35, 6 fig, 3 tab, 7 ref.

Descriptors: *Dispersants, *Oil spills, *Emulsions, *Surfactants, Oil, Chemical treatment, Cleanup operations, Performance evaluation.

The various factors affecting the performance of oil spill dispersants have been studied in the laboratory using a simple test to emulsify the oil in the water. The observations have been confirmed by spraying oil onto the sea followed by overspraying with dispersant. It was found that viscosity of the oil or mousse was the main limitation that influenced the droplet size distribution. Energy of agitation had a minor effect but there was no evidence that the 'self-mix' dispersants required less energy for adequate dispersion. (Author's abstract)
W87-09511

BIODEGRATION OF CHEMICALLY DISPERSED CRUDE OIL,
Department of the Environment, Victoria (British Columbia). Inst. of Ocean Sciences.
For primary bibliographic entry see Field 5B.
W87-09512

DISTRIBUTION OF AROMATIC HYDROCARBONS IN PORT VALDEZ, ALASKA,
Rockwell International, Newbury Park, CA. Environmental Monitoring and Services Center.
For primary bibliographic entry see Field 5B.
W87-09513

EFFECTIVENESS OF OFFSHORE PRODUCED WATER TREATMENT,
Rockwell International, Newbury Park, CA. Environmental Monitoring and Services Center.
For primary bibliographic entry see Field 5D.
W87-09515

TOXICITY OF CHEMICALLY DISPERSED OIL TO SHRIMP EXPOSED TO CONSTANT AND DECREASING CONCENTRATIONS IN A FLOWING SYSTEM,
Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.
For primary bibliographic entry see Field 5C.
W87-09516

ONSHORE IMPACTS AND CLEANUP DURING THE BURMAH AGATE OIL SPILL - NOVEMBER 1979,
Research Planning Inst., Inc., Columbia, SC.
For primary bibliographic entry see Field 5C.
W87-09518

BURMAH AGATE - CHRONOLOGY AND CONTAINMENT OPERATIONS,
Research Planning Inst., Inc., Columbia, SC.
For primary bibliographic entry see Field 5B.
W87-09519

BIOS PROJECT - FRONTIER OIL SPILL COUNTERMEASURES RESEARCH,
Environmental Protection Service, Edmonton (Alberta).
P. J. Blackall, and G. A. Sergy.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 167-172, 1 fig, 3 ref.

Descriptors: *Oil spills, *Cleanup operations, *Performance evaluation, *BIOS Project, Oil slicks, Dispersants, Oil recovery, Oil skimmers, Environmental effects, Baffin Island Oil Spill Project, Biodegradation.

After 18 months of planning, the Baffin Island Oil Spill (BIOS) Project was formally initiated in March 1980. This project marks a major new initiative in oil spill countermeasures development for Canada's northern frontiers. The primary objectives of this internationally funded project are (1) to determine if the use of chemical dispersants in the Arctic nearshore will reduce or increase the environmental effects of spilled oil, (2) to assess the fate of oil, and (3) to compare the relative effectiveness of other shoreline protection and cleanup techniques. This paper outlines the background and scope of the 4-year project and provides an overview of the first field season's results. Highlighted are the preliminary oil discharges, which took place in August 1980, and which marked the start of studies on the long-term fate of oil on Arctic beaches. In addition, the results of the baseline physical, chemical, and biological studies are presented. The physical program included detailed oceanographic, meterological, and geomorphological studies. The chemical program determined the background hydrocarbon concentrations in the sediments, the water column, and the tissue of selected macrobenthic species; and also the environmental chemistry of the study area. The biological program characterized the macrobenthic flora and fauna and the micro-organisms that are potentially capable of biodegrading the oil. The physical, chemical, and toxicological properties of the oil were measured in laboratories and in the field. The ramifications of these results on the design of the oil spills scheduled for 1981 are discussed. (Author's abstract)
W87-09523

DOME PETROLEUM'S OIL SPILL RESEARCH AND DEVELOPMENT PROGRAM FOR THE ARCTIC,
Dome Petroleum Ltd., Calgary (Alberta).
W. M. Pistruzak.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 173-181, 16 fig, 23 ref.

Descriptors: *Oil spills, *Cleanup operations, *Performance evaluation, Oil slicks, Dome Petroleum Ltd., Oil recovery, Ice breakup, Ice cover.

Canadian Marine Drilling (Canmar), a wholly owned subsidiary of Dome Petroleum Ltd., is conducting exploratory drilling in the Beaufort Sea with the objective of onstream production by the mid-1980s. If a major oil well blow-out should occur, and the probability of such an occurrence is very small, oil would be released to the surface of the sea until a relief well could be drilled or the well sealed itelf. The relief well could be drilled during the same drill season, or, in the worst case, it might not be completed until the following year. Therefore, Dome could be faced with the problem of cleaning up an oil spill during open-water, freeze-up, and winter or spring break-up conditions. To this end, Dome has developed a contingency plan, based on, and updated according to, its ongoing research and development programs to deal with an oil spill during each of the abovementioned periods of time. To date, Dome has invested approximately $10 million in its research and development programs. This paper deals with Dome's research and development in oil spill countermeasures for its present ongoing exploration activities and its future production and transportation systems. (Author's abstract)
W87-09524

DOME'S PETROLEUM STUDY OF OIL AND GAS UNDER SEA ICE,
Dickens (D. F.) Engineering, Vancouver (British Columbia).
D. F. Dickens, I. A. Buist, and W. M. Pistruzak.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 183-189, 9 fig, 2 tab, 8 ref.

Descriptors: *Oil spills, *Oil recovery, *Performance evaluation, *Sea ice, *Beaufort Sea, Cleanup operations, Distribution patterns, Oil pollution, oily water.

The main cleanup of an oil spill originating from a late-season oil well blowout in the Beaufort Sea would take place in the spring. It is at this time that the oil trapped in and under the ice would surface to accumulate in melt pools on top of the ice. To unify all the previous work on oil migration and in-situ burning, Dome Petroleum Ltd. undertook a major oil spill experiment during the winter of 1979/80 in the Beaufort Sea. The objective of this field experiment was to determine the efficiency of burning as a countermeasure and to optimize burning techniques for oil and gas released from a Beaufort Sea blowout under ice. The experiment took place in three phases, approximately 8 km offshore from McKinley Bay in the Beaufort Sea, in first-year ice. Approximately 19 cu m of crude oil was discharged under the ice in conjunction with gas (air). This oil surfaced in the spring in pools thick enough to burn. Some 80% of the oil discharged was removed from the marine environment. (Author's abstract)
W87-09525

CONTAINMENT OF OIL SPILLED UNDER ROUGH ICE,
ARCTEC, Inc., Columbia, MD.
For primary bibliographic entry see Field 5B.
W87-09526

KURDISTAN - AN UNUSUAL SPILL SUCCESSFULLY HANDLED,
Environmental Protection Service, Halifax (Nova Scotia).
F. C. Duerden, and J. J. Swiss.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 215-219, 4 fig, 1 tab.

Descriptors: *Oil spills, *Cleanup operations, *Oil recovery, *Oily water, Oil tankers, Distribution patterns, Oil, Kurdistan, Cabot Strait, Canada.

On March 15, 1979, the 30,000 dwt British tanker Kurdistan split two in the ice-infested waters of Canada's Cabot Strait. Approximately 7,000 tons of bunker C spilled from the ruptured tanks, but the rest remained in the floating bow and stern sections. A threefold problem faced those agencies responsible for addressing the incident: the bow section containing 7,000 tons of oil, the stern with 16,000 tons, and the escaped oil itself. Two teams of government personnel addressed the problems of the bow and stern sections. Eventually, in a precedent-setting action, the stern was towed through stormy seas and ice and offloaded at Port Hawkesbury, Nova Scotia, and the bow was sunk by naval gunfire in a predesignated area off the Scotian Shelf. Twelve days after the accident, oil started coming ashore and eventually contaminated over 700 miles of shoreline, requiring cleanup efforts lasting over 6 months. The response was difficult for a number of reasons: the oil was often trapped in ice and could not be recovered; it emerged unexpectedly oiling and reoiling shorelines for several months; and environmental and socioeconomic concerns became increasingly significant. Finally, over a million bags of oily debris were collected, requiring the development of an environmentally acceptable disposal method. All of these problems made the Kurdistan spill difficult and unique from both a response and cleanup point of view. (Author's abstract)
W87-09527

WRECK OF THE LEE WANG ZIN,
Alaska State Dept. of Environmental Conservation, Juneau.
R. Bayliss, and R. Spoltman.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 221-226, 2 fig, 12 ref.

Descriptors: *Oil spills, *Alaska, *Cleanup operations, *Environmental effects, Oil pollution, Oil recovery, Evaporation, Toxicity, Oily water, Oil, Lee Wang Zin.

Environmental effects and cleanup efforts involved in Alaska's largest (length of shoreline affected) marine oil spill are recounted. Some 2,381 to 7,143 barrels (bbl) of heavy bunker fuel and diesel were released during high winds into Alaskan and Canadian waters as a result of the 1979 Christmas Day capsize of the Taiwanese ore freighter, M/V Lee Wang Zin, off the southern edge of the Alaskan Panhandle. Over 350 miles (mi) of shoreline were contaminated within a week of the accident, and oil slicks identified as products of the spill were sited a month later, 210 mi north of the vessel's grounding site off the southeast tip of Prince of Wales Island. During tow to deep-water burial, the vessel unexpectedly sank 8 mi from an internationally known sea bird sanctuary. Overall, many sensitive fish, mammal, bird, and shellfish resources were potentially impacted, furbearers and waterfowl, probably most seriously. Moreover, severe weather conditions and rugged terrain presented unique problems for cleanup operations, access, and logistics. By the end of April, 1980, some 585 bbl of oil had been removed at a cost of $2,089,000 ($3,570/bbl). Additional oil deposits were being found and disposed of through October, but the final resting places of some oil patches still remained to be located. Oil recovery and burning methods, including a successful propane-torching technique, are described and results tabulated. Cooperative emergency and scientific efforts involved federal, state, and local representatives, including the U.S. and Canadian Coast Guards, the National Oceanic and Atmospheric Administration, U.S. Fish and Wildlife Service, U.S. Forest Service, the Alaska Department of Environmental Conservation, Alaska State Troopers, and the Ketchikan Department of Fish and Game. Monitoring of some areas will continue for several years, and it has been recommended that certain areas be dedicated for continuing scientific study. (Author's abstract)
W87-09528

COLD WEATHER RESPONSE F/V RYUYO MARU NO. 2 ST. PAUL, PRIBILOFF ISLANDS, ALASKA,
Coast Guard, Hamilton AFB, CA. Pacific Strike Team.
G. A. Reiter.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA p 227-231, 5 fig, 3 ref.

Descriptors: *Oil spills, *Cold regions, *Cleanup operations, Environmental effects, Oil pollution, Oil recovery, Oily water, Oil, Ryuyo No. 2, St. Paul Island, Pribiloff Islands, Alaska.

Response to an oil spill incident requires special decision making no matter where it may occur. However, the individuals or agencies involved in responding to an incident in cold weather regions must prepare themselves for problems that would not normally be present in warmer and more populated areas. The purpose of this paper is to present in detail the problems of access and logistics, environmental issues, and socio-economics involved in dealing with an oil spill in an isolated cold weather region. Using the grounding of, and subsequent oil spill from, the fishing vessel Ryuyo Maru No. 2 at St. Paul Island, Alaska, as the example scenario, this attempts to show the problems encountered and how they generally related to most cases in this type of climate. Included within this scenario are problems dealing with access to both the general location of the island and the grounded vessel itself, dealing with endangered species of wildlife, economics of cleanup, and the ultimate decision-making process regarding the use of FWPCA 311(d) authority. It is the intent of this paper to outline this response, highlighting the decisionmaking process in determining the use of 311(d) authority for mitigating the effects of the spill. (Author's abstract)
W87-09529

COAST GUARD ENVIRONMENTAL MISSION FULFILLED BY NAVAL SALVAGE, FRENCH FRIGATE SHOALS,
Coast Guard, Honolulu, HI. Region IX Response Team.
B. Burns, A. G. Campbell, and C. J. Adams.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA p233-241, 6 fig, 1 tab.

Descriptors: *Oil spills, *Cleanup operations, *Salvage, *Performance evaluation, *Hawaii, Oil pollution, Oil recovery, Oily water, Oil French Frigate Shoals.

Quick response to the stranding of a large freighter on French Frigate Shoals, Hawaii, by U.S. Coast Guard (USCG) and Navy salvage forces prevented a major oil spill with probably significant environmental damage and saved a valuable ship and cargo. The authority, funding, and contacts that allowed the use of Navy salvage forces on a timely basis were key elements in the USCG On-Scene Coordinator and the Region IX (Oceana) Response Team actions. (The incident particulars, including authority, funding, assets deployed, logistics problems, salvage efforts, planning, methodology, and operational problems are discussed. It was determined that efforts to mitigate possible oil spill damage, such as deployment booms, would be impractical and probably totally ineffective in the shoal and sand splits subject to open-ocean weather conditions. Lightering of Fuel and Cargo was judged to be dangerous and difficult. Salvage of the intact ship was found to be the most practical means to prevent significant environmental damage. Jettisoning of 2,100 tons of nontoxic line white clay cargo was necessary for the salvage. Logistic limitations and evaluation of tide and currents to minimize environmental impact were major concerns that limited amounts and times of discharge. The post-incident survey indicates minimal environmental damage. The incident points to the need for the creation of an 'area to be avoided' within a 50-mile radius as is currently proposed by the United States to the Intergovernmental Maritime Consultative Organization (IMCO) Committee for the Northwest Hawaiian Islands. (Author's abstract)
W87-09530

MEREDOSIA OIL TERMINAL - THE ILLINOIS RIVER FLOODS A TANK FARM,
Coast Guard District (2nd), St. Louis, MO.
A. E. Tanos.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 243-247, 8 fig.

Descriptors: *Oil spills, *Cleanup operations, *Oil skimmers, *Booms, *Illinois River, Oil pollution, Oil slicks, Oily water, Oil, Meredosia Oil, Terminal.

Rising waters on the Illinois River during April 1979 caused breaks in the levee near Meredosia, Illinois. The swollen river flooded 10,000 acres of farmland, as well as the asphalt storage tank farm of the Meredosia Oil Terminal. The 35 tanks within the terminal included several multimillion gallon tanks of hot asphalt, as well as those containing the diesel fuel for the heating system. The floodwater reached a depth of 12 ft and the hydrostatic pressure of the rising waters lifted the diesel fuel tanks and toppled them. Thousands of gallons of oil spilled from the vents at the top of the tanks, or from the broken pipelines at their bases. A westerly wind moved the oil out over the flooded farmland. The terminal operator's resources were depleted after long efforts to prevent the levee breaks. The spill-containment dike around the tank farm was underwater, so several thousand feet of floating containment boom was brought in to surround the tank farm. A Macro Class self-propelled skimmer was flown in by the U.S. Coast Guard Strike Force. However, inspections on the second day revealed that much of the oil had diffused out over the floodwater and did not appear to be recoverable. Response forces concentrated on the spilled oil within the tank farm and the potential of the toppled and floating tanks. After 3 days of cleanup, a brief, violent storm blew oily debris back to the terminal from across the lake. Now massive debris recovery effort was begun in addition to the oil recover. Cleanup efforts continued for 51 days, until June 4, 1979, the floodwaters had dropped below the tank farm's spill-containment dike. (Author's abstract)
W87-09531

UNIQUE INLAND OIL SPILL - GLENROCK, WYOMING,
Coast Guard, Hamilton AFB, CA. Pacific Strike Team.
G. O. Gehring.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 249-250.

Descriptors: *Oil spills, *Cleanup operations, *Booms, *Distribution patterns, *Wyoming, Oil pollution, Oil slicks, Oily water, Oil, Glenrock, Platte Pipeline, North Platte River.

The Platte Pipeline rupture in April 1980 at Glenrock, Wyoming, spilled approximately 8,500 barrels of crude oil into the North Platte River. The U.S. Environmental Protection Agency (EPA) Region VIII and the U.S. Coast (USCG) Pacific Strike Team responded to the initial report that 150 bbl had been spilled. Not until 2 days later were they informed of the actual amount by Marathon Pipeline, the operator of the pipeline. The rupture occurred at approximately 0100 in the morning into a drainage ditch leading to the North Platte River, which runs with currents velocities of approximately 1 to 12 knots (kt) in the 68 mi of river that was contaminated. The lack of proper containment in the local area and the extreme currents in which booms needed to be set created many problems. This report also touches on the environmentally sensitive areas, boom deployment problems, and the lack of adequately trained personnel during this spill. This particular incident had several qualities that were unique to past incidents involving the same type of product. The specific gravity of this crude was approximately 0.9129 at 60 F; however the prevailing range of extreme temperatures for this time of year (20 to 90 F) caused the oil to react differently from day to day. The river current further complicated matters and posed another unique feature of the incident - containing oil in a high flow rate. (Author's abstract)
W87-09532

ASSESSMENT OF AERIAL APPLICATION OF OIL SPILL DISPERSANTS,
Montreal Engineering Co. Ltd., Calgary (Alberta).
J. B. Smedley.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 253-257, 6 fig, 6 ref.

Descriptors: *Oil spills, *Cleanup operations, *Dispersants, *Aerial application, Oil pollution, Oil slicks, Oily water, Oil, Mexican Pemex Ixtoc I, Suffield, Alberta.

The use of aircraft in the application of oil spill dispersants was shown to be a viable technique in 1979 when aerial spraying was used for the Mexican Pemex Ixtoc I oil spill and, more recently, at the Suffield, Alberta, aerially applied dispersant field trials (September 1980). The purpose of this paper is to present the results of a review of existing technical information about three specific component parts of the aerial spraying technique. The review identified parameters that affect the efficiency of aerial spraying that are useful in assessing practical operations. (Author's abstract)
W87-09533

AERIAL APPLICATION OF DISPERSANTS AT THE IXTOC I SPILL,
Exxon Chemical Co., Houston, TX. Technology Div.
G. P. Lindblom, B. D. Emery, and M. A. G. Lara.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 259-262, 1 fig, 7 ref.

Descriptors: *Oil spills, *Cleanup operations, *Dispersants, *Aerial application, Oil pollution, Oil slicks, Oily water, Oil, Ixtoc I.

Chemical dispersants were a valuable part of the response to the Ixtoc I blowout and spill. Use of

these chemicals effectively prevented floating oil from entering near-shore environments, particularly those areas that represent the main migration routes for shrimp larvae. Selective aerial treatment of oil masses that threatened locations 20 to 25 mi (323 to 40 km) from shore was carried out along over 1,000 mi (1,600 km) of coastline. Oil treated ranged in thickness from about 50 to 75 micrometers to 0.15 to 0.2 mm. This oil appeared from the air as vast silver sheets, orange-brown emulsion, and darker brown accumulations, and represented oil concentration of about 800 to over 3,000 bbl/sq mi (49 to 184 cu m/sq km). All were successfully treated even after being on the water for 4 to 6 months. The aircraft used were Douglas DC-6B and DC-4 spray planes which had previously been tested in dispersant spraying during overland projects. These airplanes, capable of carrying over 3,000 gal (11,356 l) per flight, operated from 5 different bases during the work, and flew more than 1,000 hours on 493 missions, with an average coverage of about 2 sq mi (5.1 sq km) per spray flight. Dispersant dosage varied from 2 to 4 gal/acre (18 to 37 l/ha) over approximately 1,000 sq mi (2,590 sq km) of sea surface. This paper presents details of the spraying operations, the logistical concerns of the project and aircraft operating and navigational procedures. It also addresses the economic implications of this operation for future contingency planning and spill response. (Author's abstract)
W87-09534

OIL SPILL CLEANUP WITH DISPERSANTS: A BOOMED OIL SPILL EXPERIMENT,
Seakem Oceanography Ltd., Sidney (British Columbia).
J. Buckley, D. Green, and B. Humphrey.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 263-268, 8 fig, 2 tab, 7 ref.

Descriptors: *Oil spills, *Cleanup operations, *Dispersants, *Chemical treatment, Booms, Oil pollution, Oily water, Oil, Seawater.

Three experimental oil spills of 200, 400, and 200 liters were conducted in October, 1978, in a semi-protected coastal area on Canada's west coast. The surface slicks were restrained with a Bennett inshore oil boom. The spilled oil was chemically dispersed using Corexit 9527, applied as a 10% solution in sea water and sprayed from a boat. The dispersed oil was monitored fluorometrically for some hours. Surface and dispersed oil were sampled for chemical analysis. The highest recorded concentration of dispersed oil was 1 part per million. After a short time (30 minutes), concentrations around 0.05 ppm were normal, decreasing to background within 5 hr. The concentrations were low compared to those expected for complete dispersion which, as visual observation confirmed, was not achieved. The dispersed oil did not mix deeper into the water column with the passage of time, in contrast to predicted behaviour and in spite of the lack of a significant vertical density gradient in the sea water. This was attributed to the buoyancy of the dispersed oil droplets and the limited vertical turbulence in the coastal locale of the experiment. The integrated quantity of oil in the water column decreased more rapidly than either the mean oil concentration of the cloud or the maximum concentration indicating that some of the dispersed oil was rising back to the surface. The surfacing of dispersed oil was confirmed visually during the experiment. The mixing action of the spray boat and breaker boards apparently created large oil droplets that did not form a stable dispersion. Horizontal diffusion of the dispersed oil was initially more rapid than expected, but the rate of spreading did not increase with time as predicted. The results imply that the scale of diffusion was larger than the scale of turbulence which again can be attributed to the locale of the experiment. (Author's abstract)
W87-09535

1979 SOUTHERN CALIFORNIA DISPERSANT TREATED RESEARCH OIL SPILLS,
Chevron Oil Field Research Co., La Habra, CA.
C. D. McAuliffe, R. L. Steelman, W. R. Leek, D. E. Fitzgerald, and J. P. Ray.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 269-282, 13 fig, 3 tab, 15 ref.

Descriptors: *Oil spills, *Cleanup operations, *Dispersants, Chemical treatment, Aerial application, Oil production, Oily water, Oil, Long Beach, California.

Over a 2-day period in late September 1979, the American Petroleum Institute (API) discharged nine 10- or 20- barrel volumes of Alaskan Prudhoe Bay crude oil in a test area offshore of Long Beach, California. Two untreated slicks served as controls,; three were sprayed with a self-mix dispersant from a DC-4 aircraft; three were sprayed with the same dispersant from a boat; and one was sprayed with a second dispersant from a boat. Movies and still photographs were taken from the air, and from under the aerially treated slicks. Over 900 water samples were collected from under the slicks. These samples were analyzed for total oil and for loss of low-molecular-weight hydrocarbons. Aerial and underwater photography showed marked color changes for the better dispersed slicks. Chemical analysis showed 45 to 80% of the oil was dispersed by aerial treatment. Treating the 'lens' of the thicker oil by boat dispersed 60% of the oil, while treating the entire slick uniformly dispersed form 50 to 10%. The two tested dispersants varied in their effectiveness, confirming prior laboratory test. Under the best-dispersed slicks, the highest oil concentrations were 20 to 40 part per million at 1 m, observed 10 to 15 minutes after treatment. Other high oil concentrations were from 10 to 15 ppm at 1, 3, and 6 m; and 1 to 3 ppm at 9 m, 1 hr after treatment; thereafter concentrations decreased. Dispersed oil very rapidly lost volatile hydrocarbons (C1 to C10). Less than 1% of the oil dispersed naturally under the untreated slicks. (Author's abstract)
W87-09536

FATE AND EFFECTS OF DISPERSANT-TREATED COMPARED WITH UNTREATED CRUDE OIL, WITH PARTICULAR REFERENCE TO SHELTERED INTERTIDAL SEDIMENTS,
Masspec Analytical Specialty Services Ltd., Stroud (England).
S. J. Rowland, P. J. C. Tibbetts, D. Little, J. M. Baker, and T. P. Abbiss.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 283-293, 6 fig, 4 tab, 10 ref, append.

Descriptors: *Oil spills, *Cleanup operations, *Dispersants, *Intertidal areas, *Sediments, Chemical treatment, Oil pollution, Oily water, Oil.

Dispersant use is a factor that may partly determine the fate and effects of spilled oil. A series of quantitative field experiments has been initiated to simulate conditions following nearshore treatment of a floating oil slick or following the cleaning of a spill stranded on the shore. The basis experimental design is a series of treatments (Forties or Nigerian crude oil, BP 1100WD dispersant, or oil plus dispersant) applied to sets of experimental plots in a range of intertidal and subtidal communities. Biological recording includes frequency and density measurements of plants and animals, and hydrocarbon analysis is by capillary gas liquid chromatography and computerized gas chromatography-mass spectrometry. Additionally, the effects of dispersant on the movement and fate of oil in different types of sediment is being investigated using a laboratory sediment column and controllable temperature seawater system. The columns have been successfully used in the modeling of low-energy sedimentary environments. Particular attention has been paid to the nature of water table fluctuations within the sediment, to grain size and sorting, to permeability, and also to the number of simulated 'tides' that the columns experience after treatment. Hydrocarbon analysis is primarily by ultraviolet spectrophotometry, which has the advantage that the large number of samples generated by each experimental run can be quickly analyzed. Gas liquid chromatography is used for checking selected samples. Preliminary results from the field and laboratory experiments indicate that some dispersant treatments increase penetration of oil, and that it may be retained below the sediment surface. Interacting factors include time of treatment in relation to tidal cycle and behavior of the water table in the sediment. (See also W87-09507) (Author's abstract)
W87-09537

SPILL IMPACTS AND SHORELINE CLEANUP OPERATIONS ON ARCTIC AND SUB-ARCTIC COASTS,
Woodward-Clyde Consultants, Victoria (British Columbia).
E. H. Owens, and G. A. Robilliard.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 305-309, 1 fig, 6 ref.

Descriptors: *Oil spills, *Cleanup operations, *Cold regions, *Seawater, Oil slicks, Distribution patterns, Oil pollution, Oily water, Oil, Arctic, Environmental effects.

Spill response operations in ice-infested or Arctic environments must take into account environmental factors or constraints that are not applicable in more temperate climates. In particular, the potential impact of oil on biological habitats or communities must be evaluated carefully in terms of species distributions and population abundance at the time of a spill. The potential natural recovery from spilled oil is reduced because of the modifying effects of ice on mechanical (wave) processes at the shoreline. Stranded oil is likely to persist longer because of reduced thermal and mechanical energy levels and would, therefore, have a longer potential adverse effect on biological communities. Environmental conditions may constrain operational response in areas of ice-infested waters or of low temperatures. These climatic conditions have not favored human activities so that many Arctic regions are remote and response resources are greatly limited. The development of spill response decisions in Arctic regions must focus on (1) the necessity for cleanup versus natural recovery, (2) assigning priorities for the protection and/or cleanup of specific sections of coast, and (3) consideration of logistic or other operation constraints resulting from climatic conditions. (See also W87-09507) (Author's abstract)
W87-09538

COASTAL ECOSYSTEM STUDIES AND THEIR APPLICATION TO OIL SPILL RESPONSE,
National Coastal Ecosystems Team, Slidell, LA.
For primary bibliographic entry see Field 5C.
W87-09539

RESTORATION OF OILED MARSHES THROUGH SEDIMENT STRIPPING AND SPARTINA PROPAGATION,
St. Mary's Coll. of Maryland, St. Mary's City.
C. T. Krebs, and C. E. Tanner.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 374-385, 5 fig, 4 tab, 47 ref.

Descriptors: *Oil pollution, *Marsh restoration, *Oil spills, *Cleanup operations, *Potomac River, Marshes, Sediments, Hydrocarbons, Oil, Environmental effects, Estuaries.

Following the contamination of a low marsh in the Potomac River estuary from an accidental spill of No. 6 fuel oil, 12 plots were established for the study of the effects of surface stripping and Spartina alterniflora propagation on the recovery of marsh grass and invertebrate populations. Sediment hydrocarbons in the oiled control plots ranged from approximately 1,500 to 17,000 micrograms/g. Distribution of hydrocarbon concentrations also demonstrated an elevation gradient, decreasing with increasing elevation in the intertidal zone. Hydrocarbon concentrations in the oiled plots that had been stripped were similar to those in the unoiled plots and are within the range of values reported for biogenic hydrocarbons in marshes. When sediment hydrocarbon concentra-

tions were below 2,000 micrograms/g, S. alterniflora was not affected or showed slight increases in stem height, density, and aboveground biomass during the first growing season. For concentrations above 2,000 micrograms/g, all of these parameters decreased with increasing hydrocarbon concentrations. Total shoot height and ratio of dry weight to stem height decreased at all hydrocarbon concentrations. Flowering was simulated by the oiling. In areas with hydrocarbon concentrations above 10,000 micrograms/g, most of the underground rhizomes were killed, and little natural regrowth occurred. The densities in stripped plots and stripped and backfilled plots were similar to the density of the unoiled control plots by the end of the second growing season. Transplants grew throughout the elevation range of stands of S. alterniflora, whereas few seedlings survived in the lowest one-third of the range. Oiling and/or the initial cleanup procedures caused a marked reduction in population densities of the marsh periwinkle, Littorina irrorata, and ribbed mussels, Geukensia demissa, and altered the size-class distribution of the snail populations. The reduction in densities of the mussel and snail populations was related to the sediment hydrocarbon concentrations. Reestablishment of faunal populations in both heavily oiled control plot and the stripped plots occurred following recritment of juveniles from the plankton. (See also W87-09507) (Author's abstract)
W87-09546

CONTAMINATION OF GROUNDWATER BY HYDROCARBONS FROM A REFINERY - A CASE HISTORY,
O'Connor (M.J.) and Associates Ltd., Calgary (Alberta).
M. J. O'Connor, A. M. Wolford, and R. M. Richardson.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 393-300, 8 fig.

Descriptors: *Groundwater, *Groundwater pollution, *Oil pollution, *Oil recovery, Cleanup operations, Oil refineries, Hydrocarbons, Calgary, Alberta.

The Gulf Canada Products Company Asphalt Plant and Terminal in Calgary, Alberta, operated for almost four decades without a serious environmental incident. In February 1978, however, hydrocarbons were discovered seeping from the bank of a lagoon in the Inglewood Bird Sanctuary, a wildlife preserve located adjacent to the refinery. An investigation was immediately undertaken to determine the origin and extent of the subsurface contamination. Measures were concurrently adopted to intercept the flow of petroleum products before their entry into the lagoon, so that any adverse effects on migrating waterfowl could be minimized. A subsurface horizontal box culvert and impermeable curtain assembly along the leading edge of the contaminant were designed and constructed. Hydrocarbons that accumulated in the box culvert were removed with a vacuum truck. Subsequent studies, which comprised the drilling and monitoring of over 70 test holes, revealed that approximately 16 hectares under the Bow River floodplain had been contaminated by a layer of hydrocarbons up to 1 m in thickness and up to 8,000 cu m (50,000 bbl) in volume. It was concluded that the petroleum products had been lost to the subsurface during the normal course of operations over 40 yr and had accumulated on the groundwater table in a stratigraphic trap under the plant site. The recent release of the contaminant can be attributed to a unique set of hydrogeologic conditions. Following the investigation a series of three abstraction wells were placed at critical locations within the contaminated area. Each well contained separate pumps for withdrawal of both the groundwater and petroleum products. Collection is facilitated by piezometric drawdown caused by pumping clean groundwater at a rate of approximately 0.068 cu m/sec (1,080 gpm). The same water is used to recharge the water-table aquifer inside the plant site, thus diverting any future spillage into the abstraction facility. Hydrocarbons recovered from each well are pumped, via an underground pipeline directly back to the plant, where they are re-refined. Monitoring of the contaminant and the cleanup operations is currently in progress. (See also W87-09507) (Author's abstract)
W87-09547

EFFECTS OF OIL SPILL CLEANUP TECHNIQUES ON A SALT MARSH,
Lamar Univ., Beaumont, TX. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W87-09548

RESPONSE TO THE ESSO BAYWAY OIL SPILL,
Exxon Co., U.S.A., Houston, TX. Marine Dept.
R. J. Meyers.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 409-412, 2 fig.

Descriptors: *Oil spills, *Fuel, *Cleanup operations, *Performance evaluations, *Texas, Environmental effects, Oil, Esso Bayway, Neches River.

The 50,000 dwt tanker Esso Bayway punctured a hole in its bottom on January 28, 1979, spilling 6,500 barrels (bbl) of Light Arabian crude oil into the Neches River near Port Arthur, Texas. Oil impacted 3 miles (mi) of the river, adjacent bayous, and an environmentally sensitive salt marsh. This paper describes the response to the spill by the Exxon Company, U.S.A., Marine Department. Several contractors used a variety of cleanup methods for collection and recovery of the oil during the 30-day operation. The preplanned implementation of an emergency response by an Exxon team of managers, supervisors, scientists, public affairs advisors, claims agents, accountants, and communications experts to coordinate the cleanup operation is discussed. In addition to the Exxon response team, scientists from academia were retained to provide guidance in the assessment of any potential environmental impacts. The United States Coast Guard (USCG), the U.S. Environmental Protection Agency (EPA), the National Oceanic and Atmospheric Administration (NOAA), acting as the Scientific Support Coordinator, and state agencies also participated in the cleanup operation. Cleanup was completed in 4 weeks at a cost of $1.5 million with minimum private claims, insignificant environmental damage, and positive media coverage and public reaction. This paper describes the efforts that obtained these results. (See also W87-09507) (Author's abstract)
W87-09549

IMPACTS OF A SPILL OF NO. 6 FUEL OIL ON LAKE WINONA,
Winona State Univ., MN. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W87-09551

IXTOC I OIL SPILL - THE DAMAGE ASSESSMENT PROGRAM AND ECOLOGICAL IMPACT,
For primary bibliographic entry see Field 5C.
W87-09554

OIL SLICK IGNITER FOR REMOTE AREAS,
Environmental Protection Service, Ottawa (Ontario). Environmental Emergencies Technology Div.
K. M. Meikle.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 617-621, 2 fig, 1 tab, 3 ref.

Descriptors: *Oil spills, *Oil slicks, *Igniters, *Incineration, Aircraft, Cold regions, Sea ice, Ice, Oil, Arctic.

Two air-droppable igniters have been developed to ignite oil on the surface of melt pools on Arctic ice floes and in other remote, difficult-of-access locations. Performance has been satisfactorily demonstrated by prototype tests under both laboratory and field conditions. A substantial amount of spilled oil that would be prohibitively unsafe or expensive to remove by any other means can now be burned off to reduce adverse effects on the environment. (See also W87-09507) (Author's abstract)
W87-09559

DEVELOPMENT OF A FLARING BURNER OIL DISPOSAL SYSTEM,
Seaward International, Inc., Falls Church, VA.
For primary bibliographic entry see Field 5D.
W87-09560

FLOW AROUND SPILL CLEANUP DEVICES,
R. A. Griffiths.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 631-635, 2 fig, 18 ref.

Descriptors: *Oil spills, *Cleanup operations, *Oil skimmers, *Booms, Flow patterns, Testing procedures, Oil.

This paper discusses the implications of testing oil booms and skimmers in a tank of finite size. Scaling considerations, test conditions, and bottom effects are treated. General descriptions of the gross flow patterns around booms and skimmers are presented, and the significance of these patterns to containment and recovery is discussed. Tank tests are compared with full-scale field conditions, and flow patterns and problems in the field are discussed. It is shown that tests done at small scales may be scaled up readily in most cases, because the gross flow patterns about objects are the same over a wide range of scales. The primary features of the gross flow patterns are cavities, or circulation zones, in front of and behind the object and vortex sheets along lengths of boom parallel to the flow. The flow in the cavities will be strongly affected when the ratio of boom draft to water depth exceeds one-sixth inch. Boom or skimmer performance may be worse in very shallow water than in deep water because of the increased speeds around the device. This may lead to increased vortex drainage, earlier oil entainment at the headwave, and increased drag. Booms with little draft may slightly outperform larger booms in these cases. In addition, if the backup booms in a multiple-boom installation are spaced too closely, containment may be impaired rather than enhanced. (See also W87-09507) (Author's abstract)
W87-09561

OPEN OCEAN SKIMMER PERFORMANCE TESTS,
Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ.
H. W. Lichte, M. Borst, and G. F. Smith.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 637-642, 2 fig, 1 tab, 9 ref.

Descriptors: *Oil spills, *Cleanup operations, *Oil skimmers, *Performance evaluation, *Spilled oil containment kit, SOCK, Oil, Oil pollution.

An oil skimmer was tested in a controlled crude oil dumping off the New Jersey Coast in early 1980. The program was sponsored by the U.S. Navy (USN), Director of Ocean Engineering. Supervisor of Salvage through the Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) Interagency Technical Committee comprised of the U.S. Environmental Protection Agency (EPA), U.S. Coast Guard (USCG), U.S. Geological Survey (USGS), USN, and Environment Canada. The tests were designed to evaluate the Spilled Oil Containment Kit (SOCK) developed by Shell Development Company. The skimmer had been designed as a physical attachment to an oil industry work boat in a vessel of opportunity deployment mode. The USNS Powhatan T-ATF fleet tug as chosen as a similar vessel and one that had an oil spill recovery operations mode. The test program is described including the oil/water distribution and collections system, deployment and retrieval of the SOCK, the onboard fluid measurement, data analysis, logistics, weather and environment measurements, and the Powhatan/SOCK interface. The light crude oil and ocean water collected were stored aboard the vessel, decanted, and the emulsified oil later sold as waste oil. Eight

experimental crude oil dumps are described and analyzed. The sea conditions varied from calm to 1.8 m significant heights. During the 6 days at sea, 50 cu m of oil were dumped and the skimmer collected 32 cu m of oil. The program is analyzed for suggestions to future open ocean testing plans incorporating oil skimmers with and without vessels of opportunity. This program was fortunate in having available a skimmer that had extensive testing as a model, seaworthiness testing on commercial work boats, and oil-collecting experience in a spill of opportunity. (See also W87-09507) (Author's abstract)
W87-09562

DEVELOPMENT AND TESTING OF A WEIR BOOM FOR OIL RECOVERY AT SEA,
British Petroleum Co., Ltd., Middlesex (England). Research Centre.
H. B. Wilson.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 643-648, 7 fig, 2 ref.

Descriptors: *Oil spills, *Oil recovery, *Cleanup operations, *Weir boom, Performance evaluation, Booms, Oil, Ixtoc I.

A combined oil containment and recovery system based on a weir boom principle has been designed and developed for high-rate oil spill recovery at sea. A full-scale research prototype system was tested at the Ixtoc I well blowout site in November 1979 by courtesy of Petroleos Mexicanos. The results have shown that the system design target, specifically to recover 7,500 tons of oil or mousse per day per unit in conditions up to sea state 5, with winds up to force 5 on the Beaufort scale, significant wave heights up to 3 meters, and wave periods in the range of 3 to 12 seconds, is achievable. The work has been carried out by the British Petroleum Company with support from the Norwegian and British Governments. (See also W87-09507) (Author's abstract)
W87-09563

EXPERIENCES GAINED FROM DEPLOYMENT OF BOOMS AND SKIMMERS IN VARIOUS OIL RECOVERY APPLICATIONS,
E. Blomberg, O. Terling, and G. Terling.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 649-653, 11 fig.

Descriptors: *Oil spills, *Oil recovery, *Cleanup operations, Oil skimmers, Booms, Oil, Cold regions, Pumping, Viscosity.

A new skimmer-boom system has been designed in Scandanavia to retrieve any type of oil, regardless of viscosity. It has been successfully demonstrated in oil spill cleanup tests and operations, including the recovery of 400 of the 600 tons of extremely viscous oil spilled among the ice floes of the Danish coast. The skimmer unit alone, equipped with a lightweight hydraulic power pack, can also be submerged to pump out cargo or fuel oil tanks on disabled ships, to remove bottom sediment from tanker or crude oil storage tanks, or can be used in any application requiring the pumping of cold, heavy oil. The system's greater viscosity-handling range and pumping capability, compared with those of other currently available systems, are achieved by the use of a modified Archimedes' screw incorporating a slotted rotary disc that prevents fluid backup through the screw under increased pumping pressures. The pump can also accept spill-related debris such as seaweed, plastics, ice, dead sea birds, etc., without clogging. Deployment methods and the associated use of floating oil-receiving containers are described. The systems is now being built in on some Scandanavian ships that are used to fight oil spills. Techniques for recovering oil close to shore (by means of spurbooms, small screw skimmers, and shore-based collection vessels), as well as the use of external tension line system in conjunction with booms in tidal or reversing current situations are also discussed. (See also W87-09507) (Author's abstract)
W87-09564

COHERENT, PLUNGING WATER JETS FOR OIL SPILL CONTROL,
Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ.
J. H. Nash, and M. G. Johnson.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 655-660, 12 fig, 4 ref.

Descriptors: *Oil spills, *Cleanup operations, *Water jets, *Distribution patterns, Performance evaluation, Oil skimmers, Booms, Oil slicks.

The United States Environmental Protection Agency (EPA) Oil and Hazardous Materials Simulated Environmental Test Task (OHMSETT) has designed a wide variety of water jet applications for control of spilled oil. This latest study reveals the advantage of using a simple nozzle consisting of a standard pipe mounted to produce a coherent vertical jet of water downward. Examples are illustrated with test data for several cost effective, field erectable systems using standard available water pumps and hardware. One system uses a series of jets to converge a 4.5 m wide, 1 mm thick slick to 0.6 m wide by 8 mm thick, moving at 6 knots in waves. The report reviews experience and test data obtained with a small barge, weir-type skimmer, mounted on a diverting inflatable boom system. This can be used to simulate the new USCG-ZRV fast current skimmer, the Bennett advancing belt skimmer, the U.S. Navy offshore spill tests, and dock simulations with the OHMSETT main bridge. Advancing skimmers may use the water jet boom system for three reasons. First, it allows an encounter width wider than the skimmer. Next, it will cause a thin slick to become thicker, thereby possibly allowing the skimmer oil pickup techniques to be more efficient. A water jet system can be used to couple a boom-towed skimmer and prevent skirt losses at the skimmer entrance. Future experiments are planned to field tests the water jets in fixed and mobile applications on inland waterways. (See also W87-09507) (Author's abstract)
W87-09565

DESIGN ASPECTS OF THE FIRST 'SLICK-TRAIL' DREDGER, THE COSMOS,
JHC Holland, Kinderdijk. Research and Development Dept.
N. J. Van Drimmelen.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 667-673, 7 fig.

Descriptors: *Oil recovery, *Oil spills, *Cleanup operations, Oil pollution, Oil skimmers, Ships, Oil.

Having launched the concept of a combined trailing-suction hopper dredger and large-scale oil-recovery vessel in 1978, IHC Holland received an initial order for a vessel of this type in 1979. The oil-recovery installation of this ship reflects the experience gained by the Netherlands State Waterways Board (Rijkswaterstaat) in the operation of its oil-recovery vessel Smal Agt. The first 'Slick-trail' was ordered by a consortium of three Dutch contracting companies. The vessel was completed at the end of 1980 and is now engaged in maintenance in the Rotterdam Europoort area; but in the event of a major oil spillage, it is available for recovery operations in a much larger area. This paper discussed the design aspects of the Cosmos and the oil-recovery and the other special installations on board. Recovery capacity naturally depends on factors such as weather, oil type, and operational conditions, but under favorable circumstances, it can be in excess of 5,000 cu m every 24 hours. (See also W87-09507) (Author's abstract)
W87-09566

PROTECTION OF THE KARSTIC SPRINGS SYSTEM IN GOLUBINKA AGAINST CONTAMINATION BY THE SEA WATER (LA PROTECTION DU SYSTEME DES SOURCES KARSTIQUES DE GOLUBINKA CONTRE LA CONTAMINATION PAR LA MER),
Elektroprojekt, Zagreb (Yugoslavia).
For primary bibliographic entry see Field 4B.
W87-09582

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

EXPERIMENTAL MONTHLY LONG LANGE FORECASTS FOR THE UNITED KINGDOM: PART III. SKILL OF THE MONTHLY FORECASTS.
For primary bibliographic entry see Field 2B.
W87-08701

STABILITY AND INSTABILITY OF AN ADAPTIVE RESOURCE REPLACEMENT STRATEGY IN AND AGROECOLOGICAL PRODUCTION SYSTEM,
Eotvos Lorand Univ., Budapest (Hungary). Computing Center.
P. Racsko.
Ecological Modelling ECMODT, Vol. 35, No. 3/4, p 165-174, March 1987. 2 fig, 13 ref.

Descriptors: *Stability analysis, *Model studies, *Mathematical studies, *Steady states, *Agriculture, *Agroecological systems, Mathematical equations, Crop yield, Resources management, Replenishment, Replacement strategies.

Modern agricultural production mostly depends on the production output and resource input control strategy applied. However, the real output is strongly influenced by external factors like weather conditions, market prices of the products and resources, etc. The necessary and sufficient conditions were given for stability of steady-states of the investigated agroecological production system driven by a quite commonly used control strategy concept. The control strategy includes a prefixed and required output flow of products and an input flow of resources replacing the system's internal resources used for production or reduced due to natural losses. It was shown that an 'adaptive' replacement strategy stabilizes the system only at an early stage of its evolution. (Author's abstract)
W87-08784

WATER RESOURCES AUDIT FOR SMALL COMMUNITIES,
Texas Tech Univ., Lubbock. Water Resources Center.
For primary bibliographic entry see Field 5F.
W87-08953

INSTITUTIONAL ANALYSIS IN COMMUNITY DECISION-MAKING: A CASE EXAMPLE FROM SOUTHERN ARIZONA,
Arizona Univ., Tucson.
H. J. Cortner, and F. L. Marsh.
Water Resources Bulletin WARBAQ, Vol. 23, No. 2, p 317-324, April 1987. 1 fig, 19 ref.

Descriptors: *Institutional analysis, *Decision making, *Case studies, *Arizona, *Planning, Water resources, Model studies, Tucson, Basins.

While there is increasing recognition of the need to consider institutional factors in water resources decision-making, there are few specific methods available to use in actually conducting an institutional analysis. The lack of such methods has spurred interest in going beyond begging water resource agencies to conduct institutional analyses to developing more refined tools to use in the analysis process. However, as more complex systems of analysis are developed, it is important not to lose sight of the value that less objective and participatory approaches to institutional analysis may have in solving institutional problems. Improving the techniques and tools of institutional analysis should not mean developing complex methods or models that can only be manipulated and understood by the trained analyst. The advantages and disadvantages of full participation by stakeholders in the institutional analysis process are discussed by describing the efforts of a local community organization in Tucson, Arizona, to study the need for a basinwide management entity. (Author's abstract)

W87-08981

SMALL-SCALE HYDROELECTRIC POWER.
Wyoming Water Development Commission.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as DE84-015413. Price codes: A03 in paper copy, A01 in microfiche. DOE Report No. DOE/R8/07237--T1, April 1983. 18 p, 3 append.

Descriptors: *Hydroelectric power, *Project planning, *Cost analysis, *Wyoming, *Feasibility studies, Financial feasibility, Evaluation, Electric power production, Irrigation districts, Water resources development, Financing, Public participation, Economic aspects.

The Wyoming Water Development Commission has been working under agreements with the Department of Energy to conduct financial feasiblity studies for the development of small scale hydroelectric projects within the State of Wyoming. Feasibility studies conducted on the Jackson National Fish Hatchery were found to be uneconomical. Retrofilling an existing irrigation system with a hydroelectric generator in the Cottonwood Irrigation District was deemed feasible, but the irrigation district has been unsuccessful in contracting for the sale of their excess power, and the fate of this project is uncertain. Replacing a natural irrigation drop with a buried pipeline in the Prairie Dog Irrigation District would cost approximately 2.5 million dollars. The 1983 Wyoming Legislature appropriated $25,000 for a feasibility study for this project. Development of hydropower on the existing Willwood Diversion Dam would be cost effective at a finance rate below 7%. The building of a new diversion dam on the Shosone River will probably not be feasible. A plan to construct an artesian well to develop more pressure for a potential hydroelectric project for the Wyoming Game and Fish Department appears feasible. Feasibility studies were also conducted for a private land owner who wished to build a dam on a stream to develop hydroelectric power and for other water development projects that may not be under consideration solely for hydropower development. (Geiger-PTT)
W87-09110

IRRIGATED AGRICULTURE AND GROUNDWATER QUALITY--A FRAMEWORK FOR POLICY DEVELOPMENT,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
B. C. Saliba.
American Journal of Agricultural Economics, Vol. 67, No. 5, p 1231-1237, 1985. 1 tab, 15 ref.

Descriptors: *Groundwater management, *Policy making, *Water quality management, *Irrigation effects, *Agriculture, *Legal aspects, *Economic aspects, *Regulations, *Marketing, Administrative decisions, Groundwater, Groundwater pollution,, Nitrates, Pesticides, Dissolved solids, Irrigation, Water pollution sources, Public policy, Water policy, Crop yield, Water rights, Water quality standards, Water use, Planning, Nitrogen.

One of the chief difficulties with developing protective policies for groundwater quality is the lack of information on the value of water quality. In areas with water supplies of varying quality, water markets may provide indications of value. Moreover, transferable water rights can coordinate user quality preferences with available water of varying quality. The opportunity to sell water rights could also provide agricultural and other water users with incentives to protect their water sources; these need to be reinforced by regulation in order to assure a minimal level of water quality to market participants. A mixed private market/public regulation approach would permit some water sources to be degraded and limited to low-quality uses while maintaining others for current and future high-quality uses. Observed market values, combined with inferential and contingent valuation of recreational and other nonmarket uses, can help planners move toward efficient differential protection of water resources. (Author's abstract)
W87-09212

INTERACTIVE COMPUTER-AIDED WATER RESOURCES AND ENVIRONMENTAL PLANNING USING COLOR RASTER GRAPHICS: PROGRAM DESCRIPTION AND USER'S GUIDE,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 7C.
W87-09426

WATER QUALITY ASSESSMENT: A SCREENING PROCEDURE FOR TOXIC AND CONVENTIONAL POLLUTANTS, PART 1,
Tetra Tech, Inc., Lafayette, CA.
For primary bibliographic entry see Field 5B.
W87-09462

INFLUENCE OF STRUCTURE ON UNDERGROUND WATER PREDICTION AND OCCURRENCE AT ROKANA MINE, KITWE, ZAMBIA,
Nchanga Consolidated Copper Mines Limited, Kitwe (Zambia). Geology Dept.
For primary bibliographic entry see Field 2F.
W87-09572

GROUNDWATER CONTROL IN OPENCAST MINING OF A LIGNITE DEPOSIT IN SOUTHERN GREECE,
Public Power Corporation Administration of Mines, Athens (Greece).
For primary bibliographic entry see Field 4B.
W87-09583

DEVELOPMENT OF A GROUND WATER HAZARD MAP FOR AN UNDERGROUND COAL MINE,
D'Appolonia Consulting Engineers, Inc., Englewood, CO.
For primary bibliographic entry see Field 2F.
W87-09585

6B. Evaluation Process

GEOTHERMAL RESERVOIR ENGINEERING EXPERIENCE IN ICELAND,
Vatnaskil, Reykavik (Iceland).
For primary bibliographic entry see Field 6G.
W87-08830

FLOOD DAMAGE MODEL FOR FLOOD PLAIN STUDIES,
Moncton Univ. (New Brunswick). School of Engineering.
For primary bibliographic entry see Field 2E.
W87-08965

VALUING WILDLIFE IN BENEFIT-COST ANALYSES: A CASE STUDY INVOLVING ENDANGERED SPECIES,
Maine Univ. at Orono. Dept. of Agricultural and Resource Economics.
K. J. Boyle, and R. C. Bishop.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 943-950, May 1987. 3 tab, 31 ref.

Descriptors: *Endangered species, *Wildlife, *Social values, *Recreation demand, *Benefits, *Model studies, Estimating, Case studies, Wisconsin.

The focus of the research presented is to ask what types of values are relevant in the valuation of wildlife species for benefit-cost analyses of projects that may affect wildlife or its habitat. First, the components of value for wildlife resources are discussed, with emphasis on those particularly relevant to the valuation of endangered species. A simple model is then proposed and results from an application to valuing two of Wisconsin's endangered species of wildlife are presented. The empirical results indicate that significant values may be associated with endangered species of wildlife above and beyond those that arise from viewing these species in the wild. We conclude that to overlook values for wildlife species that go beyond common use values may result in a misleading project or policy decision. (Author's abstract)
W87-09032

ECONOMIC DIFFERENCES BETWEEN CUMULATIVE AND EPISODIC REDUCTION OF SEDIMENT FROM CROPLAND,
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
For primary bibliographic entry see Field 2J.
W87-09090

EXAMPLE MODEL APPLICATIONS,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 4C.
W87-09105

SMALL-SCALE HYDROELECTRIC POWER.
Wyoming Water Development Commission.
For primary bibliographic entry see Field 6A.
W87-09110

EVALUATIONS OF THE RECREATIONAL POTENTIAL OF RESERVOIRS IN DESIGN PRACTICE,
For primary bibliographic entry see Field 2H.
W87-09360

SOCIAL AND ECONOMIC IMPACTS OF SELECTED POTENTIAL DREDGED MATERIAL CONTAINMENT FACILITIES IN LONG ISLAND SOUND.
Center for the Environment and Man, Inc., Hartford, CT.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-122620, A16 in paper copy, A01 in microfiche. CEM Report No. 4280-08-735, September 1981. 347 p, 19 fig, 44 tab, 65 ref, 6 append. Contract No. DACW33-80-C-0118.

Descriptors: *Dredging, *Ocean dumping, *Long Island Sound, *Connecticut, *New York, *Spoil banks, Social aspects, Economic aspects, Economic impact, Environmental impact statement, Environmental management, Environmental quality, Environmental protection.

The study discusses the analysis of social and economic impacts associated with the construction of prototype dredged material containment facilities at six potential locations along the Connecticut shoreline in Long Island Sound. The analysis includes determination of the economic efficiency of each of the six prototype containment facilities (Morris Cove in New Haven Harbor, Fayerweather Island in Black Rock Harbor, Yellow Mill Channel in Bridgeport Harbor, Clinton Harbor, Twatree Island of Waterford, and Black Ledge at the mouth of New London Harbor), and comparison with alternative disposal methods. (Author's abstract)
W87-09471

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

APPLYING ECONOMIC PRINCIPLES TO SMALL WATER SYSTEMS,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
R. M. Clark.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 5, p 57-61, May 1987. 8 fig, 4 tab, 9 ref.

Descriptors: *Water rates, *Economic aspects, *Water supply, Water demand, Water use, Management.

As a discipline, economics is often misunderstood in the water supply field. Economies-of-scale, i.e.,

increasing unit costs with decreasing capacity, is a prevailing characteristic of water supply technology, and small utilities that serve fewer than 10,000 persons account for more than 80 percent of community water suppliers in the United States. In addition, many small utilities are privately owned and must request rate increases from public utility commissions. Price inelasticity of demand also has a special relevance for water users. An understanding of economic principles and concepts is necessary for the proper management of small water systems as well as large ones. (Author's abstract)
W87-08955

ALLOCATION MODEL FOR IRRIGATION WATER COST: CASE STUDY OF THE NILE VALLEY IN EGYPT,
Cairo Univ. (Egypt). Dept. of Irrigation and Hydraulics.
M. N. Allam.
Water Resources Bulletin WARBAQ, Vol. 23, No. 2, p 207-219, April 1987. 2 fig, 7 tab, 10 ref. Supreme Council of Universities (Egypt) Grant FRCU 82009.

Descriptors: *Economic aspects, *Model studies, *Water allocation, *Water cost, *Irrigation systems, Reservoirs, Pumping plants, Water conveyance, Nile Valley, Egypt.

An allocation model for irrigation water cost, based on the Use of Facilities method, is presented. The model is developed for large-scale irrigation systems which may include multipurpose reservoirs, irrigation control works, pump stations and irrigation canals of various orders. The model accounts for the water conveyance losses as well as the water gains in the irrigation canals, and their effects on irrigation cost. It is applied to the irrigation distribution system of the Nile Valley in Egypt, which contains the High Aswan Dam, 16 irrigation structures, 12 pump stations, and numerous irrigation canals. The irrigation water cost at 29 areas representing the Nile Valley is determined. (Author's abstract)
W87-08968

ALTERNATIVE DEMAND MODEL ESTIMATORS FOR BLOCK RATE PRICING,
Arizona Univ., Tucson. Dept. of Economics.
R. B. Billings.
Water Resources Bulletin WARBAQ, Vol. 23, No. 2, p 341-345, April 1987. 3 tab, 4 ref.

Descriptors: *Data interpretation, *Model studies, *Water rates, *Water demand, *Economic aspects, *Block rate pricing, Tucson, Arizona, Estimating, Price elasticity, Statistical analysis.

Three alternative demand model estimators for water sold under block rate tariffs are examined. The models are conceptually discussed and empirically estimated using cross-section and time-series data from Tucson, Arizona. While all three techniques produce plausible elasticity estimates, the ordinary least squares and censored sample techniques are shown to produce statistically biased results. (Author's abstract)
W87-08984

PRODUCTION FUNCTIONS FOR WATER DELIVERY SYSTEMS: ANALYSIS AND ESTIMATION USING DUAL COST FUNCTION AND IMPLICIT PRICE SPECIFICATIONS,
Claremont McKenna Coll., CA. Dept. of Economics.
For primary bibliographic entry see Field 6D.
W87-09014

EXPLORING EXISTENCE VALUE,
Maryland Univ., College Park. Dept. of Agricultural and Resource Economics.
B. Madariaga, and K. E. McConnell.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 936-942, May 1987. 1 tab, 19 ref, append.

Descriptors: *Existence value, *Water quality, *Social values, *Recreation demand, *Benefits, *Model studies, Estimating.

The notion that individuals value the preservation of water resources independent of their own use of these resources is discussed. Issues in defining this value, termed 'existence value,' are explored. Economic models are employed to assess the role of existence value in benefit-cost analysis. The motives underlying existence value are shown to matter to contingent valuation measurement of existence benefits. A stylized contingent valuation experiment is used to study nonusers' attitudes regarding projects to improve water quality in the Chesapeake Bay. Survey results indicate that altruism is one of the motives underlying existence value and that goods other than environmental and natural resources may provide existence benefits. (Author's abstract)
W87-09031

ESTIMATING THE VALUE OF WATER QUALITY IMPROVEMENTS IN A RECREATIONAL DEMAND FRAMEWORK,
Maryland Univ., College Park. Dept. of Agricultural and Resource Economics.
N. E. Bockstael, W. M. Hanemann, and C. L. Kling.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 951-960, May 1987. 4 tab, 28 ref, 3 append. EPA Cooperative agreement CR-811043-01-0.

Descriptors: *Water quality, *Social values, *Recreation demand, *Benefits, *Model studies, Estimating, Boston, Policy making.

With the advent of Executive Order 12291, policy makers involved in water quality regulation are increasingly interested in assessing the benefits of their programs. Several methods for valuing water quality improvements using recreational demand models have been developed by economists, most of which depend on observing recreationists visiting an array of sites with varying water quality and costs of access. Three general types of models are described: systems of demands, discrete choice models, and the hedonic travel cost approach; the latter two models are demonstrated using a common data set on water quality and swimming behavior in the Boston area. The models are contrasted and their relative usefulness in answering policy questions explored. (Author's abstract)
W87-09033

MODELING THE DEMAND FOR OUTDOOR RECREATION,
Yale Univ., New Haven, CT. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 6D.
W87-09034

ECONOMIC, LEGAL, AND HYDROLOGIC DIMENSIONS OF POTENTIAL INTERSTATE WATER MARKETS,
Colorado Univ. at Boulder.
C. W. Howe.
American Journal of Agricultural Economics, Vol. 67, No. 5, p 1226-1230, 1985. 2 tab, 7 ref.

Descriptors: *Economic aspects, *Legal aspects, *Hydrology, *Marketing, *State jurisdiction, Case studies, Judicial decisions, Colorado, Reviews, Economic impact, Prices, Water supply, Water use.

The topic of interstate water sales, leases, or other forms of transfer is reviewed. Such proposals have arisen in Colorado, Utah, Montana, and South Dakota. These proposals have upset the equilibrium established by interstate compacts that allocated the waters of various western rivers to the riparian states. Major economic issues are discussed, including demand, supply, and regional impacts. It is concluded that this issue will be significant for a long time. There are large amounts of water that could be induced to move at relatively low prices, as illustrated by Upper Colorado Basin figures. Demand potentially exists because of continued lower basin growth and increasing uncertainty about other supplies. However, there is a great potential for divergent views of private sellers from the viewpoint taken by their state governments. More research is needed on likely changes in water use and state-wide effects of such transfers. (Author's abstract)
W87-09211

FACTORS AFFECTING WATER AND WASTEWATER RATES,
Arthur Young and Co., Charlotte, NC.
G. A. Raftelis, and J. D. VanDusen.
Public Works PUWOAH, Vol. 118, No. 2, p 61-62. 1 tab.

Descriptors: *Water rates, *Wastewater rates, *Economic aspects, Surveys, Water policy, Public policy.

A survey of 120 utilities reports on minimum charge, residential-lifeline usage, average residential usage, non-manufacturing commercial, light industrial, industrial, and heavy industrial users, presenting cubic feet and gallon usage, meter size, and water and wastewater rates for each category. Many factors influence pricing. Geographic location is important because pumping and transmission can be major system costs. Customer demand plays an important role in sizing the facilities and impacts rates, as peak demand may be significantly higher than average annual usage. The customer constituency is important because numerous high volume users can lower administrative, customer, and transmission costs while high industrial discharge can increase operating and capital costs. The level of treatment required and the quality of influent water affects treatment costs. The level of general fund subsidy can be important where larger government administrations provide services at lesser costs or where water and wastewater operations subsidize the general fund. The level of grant funding which offsets capital costs can significantly lower rates. The age of the system is influential as older systems may require more maintenance while newer systems need to have 'bugs' removed. Infiltration and inflow levels mean additional capacity and operating costs. The rate setting methodology influences the level of revenue requirements to be recovered through rates. Care should be taken in drawing conclusions regarding water or wastewater operations or maintenance in a particular community. Many factors influence water and wastewater pricing. However, comparisons among communities could signal to management that there should be reasons why one community's rates are higher or lower than another's. Analysis into why there is a difference could be helpful in examining the effectiveness of a water or wastewater operation. (McFarlane-PTT)
W87-09221

METROPOLITAN WATER MANAGEMENT,
Denver Research Inst., CO. Industrial Economics Div.
For primary bibliographic entry see Field 6D.
W87-09338

6D. Water Demand

ALTERNATIVE DEMAND MODEL ESTIMATORS FOR BLOCK RATE PRICING,
Arizona Univ., Tucson. Dept. of Economics.
For primary bibliographic entry see Field 6C.
W87-08984

PRODUCTION FUNCTIONS FOR WATER DELIVERY SYSTEMS: ANALYSIS AND ESTIMATION USING DUAL COST FUNCTION AND IMPLICIT PRICE SPECIFICATIONS,
Claremont McKenna Coll., CA. Dept. of Economics.
R. Teeples, and D. Glyer.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 765-773, May 1987. 2 tab, 15 ref, append.

Descriptors: *Cost analysis, *Water delivery, *Economic aspects, *Model studies, Estimating, Water rates, Prediction, Performance evaluation.

Both policy and technical analysis of water delivery systems have been based on cost functions that are inconsistent with or are incomplete representa-

tions of the neoclassical production functions of economics. We present a full-feathered production function model of water delivery which can be estimated from a multiproduct, dual cost function. The model features implicit prices for own-water inputs and is implemented as a jointly estimated system of input share equations and a translog cost function. Likelihood ratio tests are performed showing that a minimally constrained, full-feathered production function is a necessary specification of the water delivery operations in our sample. This, plus the model's highly efficient and economically correct parameter estimates, confirms the usefulness of a production function approach to modeling the economic activities of water delivery systems. (Author's abstract)
W87-09014

MODELING THE DEMAND FOR OUTDOOR RECREATION,
Yale Univ., New Haven, CT. School of Forestry and Environmental Studies.
R. Mendelsohn.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 961-967, May 1987. 34 ref.

Descriptors: *Social values, *Recreation demand, *Benefits, *Model studies, Estimating, Reviews.

Several of the new methodologies developed in the last 10 years to model the demand for recreation are reviewed. There are three competing approaches to modeling heterogeneous recreation sites: partitioning, hedonic, and index models. Partitioning involves grouping sites into small homogeneous sets and treating each set as a unique good (multiple-site travel cost models). Hedonic involves disaggregating goods into their component characteristics and modeling the prices and demands for the characteristics (hedonic property value and the hedonic travel cost method). The index models involve measuring choices among limited alternatives using an index of characteristics (generalized travel cost, gravity, and discrete choice models). Although much work has been done on each method, limitations are noted with each approach, and additional research needs are identified. (Author's abstract)
W87-09034

GROUNDWATER RESOURCE DEVELOPMENT,
L. Hamill, and F. G. Bell.
Butterworths, London, England. 1986. 344 p.

Descriptors: *Water resources development, *Groundwater potential, *Groundwater management, Drought, Water supply, Groundwater availability, Aquifers, Test wells, Groundwater quality, Model studies.

In 1980, the International Decade of Drinking Water and Sanitation was declared by the World Health Organization, but tragically the news during the first half of the 1980s has been dominated by reports of devastating droughts in parts of Africa. Hence the importance to mankind of a continuous clean supply of water could not have been demonstrated more effectively. Unfortunately, however, many surface sources of water are subject to extreme temporal and spatial variations, as the African droughts testify. On the other hand, groundwater represents about 98% of the world's supply of fresh water. This source is usually relatively pure and is not allowed by climatic extremes in the way that surface sources are. The challenge is to develop the groundwater resource. In England and Wales something like 30% of the total water supply is satisfied by groundwater, and in the United States this figure rises to around 50%. Obviously, in those areas centered on major aquifers the figure is appreciably higher. As the demand for water increases in such developed areas, and opposition to the construction of new reservoirs mounts, then the development of groundwater schemes is likely to assume increasing importance. Furthermore, a groundwater development scheme is not so capital intensive as that of a large reservoir project. Another advantage is that a groundwater scheme can be introduced gradually to keep pace with demand and a degree of flexibility is possible. The book describes the steps involved in the search for productive aquifers, their exploration, the construction and testing of water wells, water quality and pollution considerations, groundwater management and groundwater models. These represent the basic steps concerned with the development of a groundwater resource. (Lantz-PTT)
W87-09148

METROPOLITAN WATER MANAGEMENT,
Denver Research Inst., CO. Industrial Economics Div.
J. G. Milliken, and G. C. Taylor.
Water Resources Monograph Series 6. American Geophysical Union, Washington, DC. 1981. 180 p.

Descriptors: *Metropolitan water management, *Water demand, *Pricing, *Water treatment, Economic aspects, Water supply, Desalination, Groundwater potential, Water reuse, Wastewater renovation, Management planning, Water management.

This book is intended to inform interested and capable persons, who happen are not specialists in water resources planning, of the issues and alternative strategies related to metropolitan water supply. This involves learning something about the alternative strategies -- some ancient and others not yet operational -- for increasing water supplies and/or modifying demand so a supply/demand balance is maintained. This also requires an awareness of the complex what once was considered a purely technological problem, to be left to water resource specialists to solve. The authors address a number of complex issues in their discussion of alternative strategies for maintaining a balance between supply and demand. Among these issues are conservation, pricing policy, reallocation of agriculture water, groundwater, precipitation augmentation, desalination, and reuse of municipal wastewater. A number of these issues are at the forefront of water policy today and are likely to remain policy issues well into the future. The authors also discuss the decision making process for water supply for a metropolitan area, and present a framework for analysis. This should be a particularly useful volume for those concerned with the problems of water supply. (Lantz-PTT)
W87-09338

6E. Water Law and Institutions

AQUATIC TOXICOLOGY AND HAZARD ASSESSMENT: EIGHTH SYMPOSIUM.
American Society for Testing Materials, Philadelphia, PA.
Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. Edited by Rita Comotto Bahner and David J. Hansen.

Descriptors: *Symposium, *Aquatic toxicology, *Hazard assessments, *Water pollution effects, Toxicity, Legal aspects, Regulations, Environmental effects, Aquatic environment, Legislation.

ASTM is a voluntary consensus standards development organization. As such, most of the previous seven aquatic toxicology and hazard assessment symposia have focused on presentations relating to research aimed, directly or indirectly, at test methods development. The focus of this Eighth Symposium on Aquatic Toxicology is the utility of these methods in the regulatory and industrial context, their limits of environmental applicability and a continued discussion of improvements in the methods. In attempting to define more clearly how the research is used, the foci of the sessions was built in pyramid fashion. The symposium begins by examining how scientific data are used and interpreted by the U.S. Congress and by the European Community, a very broad base. The second session examines specific legislative mandates in the United States and the use of particular scientific disciplines in decision-making. The third session of this symposium features a debate about articulating more clearly what must be protected to achieve these environmental goals. The papers featured here focus on an examination of the role of single-species, microcosm and system level responses in decision-making. The goal of all panel members was clearly the protection of aquatic life. The fourth session on research needs responds to the goals outlined in previous papers. In the environmental sciences, knowledge is rarely sufficient and gaps in knowledge are many. The fifth session seeks to answer the following questions: How well does laboratory data predict what really happens in the environment. Can or should laboratory data be used to develop water quality criteria or predict environmental hazard, and so forth. It is obvious that the answers are not simple. The largest session of this symposium deals with new concepts and methods in aquatic toxicology. These range from biochemical tests, such as the use of a lipid index for predicting bio-uptake by daphnids, to interlaboratory studies of the variability of bioconcentration tests with one species, the eastern oyster. The last session reaches the narrowest point of the pyramid. The papers are focused on a single chemical class, dioxins. (See also W87-08625 through W87-08660) (Lantz-PTT)
W87-08624

SCIENTIFIC CONSIDERATIONS IN THE LEGISLATIVE ARENA,
R. Durbin.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 7-14.

Descriptors: *Legislation, *Aquatic toxicology, *Legal aspects, Information, Insecticides.

Decisions based on scientific information can fall into a number of different areas, such as energy, the environment, health issues, or budget issues. For example, the Science and Technology Committee recently completed action on the fiscal year 1985 authorization for all nonmilitary aspects of the Department of Energy's budget as well as the budgets of the National Science Foundation and the National Bureau of Standards. Having decided on the authorization levels for these budgets, the Appropriations Committee will now decide how much money will actually be appropriated within the authorization ceilings. Congress also makes use of scientific information in performing its oversight role. Once the Congress passes a law, such as the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), or the Toxic Substances Control Act (TSCA), it is then up to the administrative agencies to implement the law by establishing regulations and standards that must be compiled with (the four major agencies are the Environmental Protection Agency (EPA), the Federal Drug Administration (FDA), the Occupational Safety and Health Administration (OSHA), and the Consumer Product Safety Commission). Apart from the problem of conflicting information, a good example of Congress' need to consider scientific along with many other considerations is the current debate on acid rain. Acid rain legislation may come before the full House sometime this year and has already stirred up a lot of controversy over the past few years, in large part because the benefits of control would be concentrated in one section of the country, the Northeast, while the costs of control would fall heavily on another section, the Midwest. The Science and Technology Committee reported to the full House a bill that calls for the establishment of coordinated interagency research and demonstration projects to improve knowledge and use of risk assessment by the regulatory agencies. The bill has not been taken up by the full House, and there is a possibility that the Committee may again consider the risk assessment issue, so input from the scientific community would again be invaluable. (See also W87-08624) (Lantz-PTT)
W87-08625

SCIENTIFIC CONSIDERATIONS IN THE INTERNATIONAL ARENA,
Unilever Research, Bebington (England). Port Sunlight Lab.
C. M. Lee.
IN: Aquatic Toxicology and Hazard Assessment:

Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 15-26, 13 ref.

Descriptors: *Legislation, *International agreements, *Legal aspects, *Aquatic toxicology, Information exchange, International law, Hazard assessments, Regulations, Water pollution effects.

The last decade has seen the introduction of significant pieces of national legislation to control the use of chemicals and ensure their human and environmental safety. In the last five years the Organization for Economic Co-operation and Development (OECD) Program on Chemicals has achieved significant international harmonization of the principles and many of the methods for assessing the potential hazard of chemicals to man and the environment. The mutual acceptance of data between nations using these harmonized methods has also been agreed and will contribute to the avoidance of nontariff barriers to trade and the unnecessary duplication of effort. Despite these achievements, however, the scientific and legislative communities have yet to learn how to communicate fully and effectively. The development of standard methods remains too slow, and too little attention is paid to the validation of methods, which is hindering the international harmonization process. Considerable scope remains for the improvement of the mechanism by which international harmonization is achieved. This should include establishing closer links between the standardization organizations and those developing legislation and deriving an approach that will avoid the premature introduction of research results. (See also W87-08624) (Author's abstract)
W87-08626

CLEAN WATER ACT UPDATE: A NEW ROLE FOR TOXICOLOGY,
Environmental Protection Agency, Washington, DC. Office of Analysis and Evaluation.
P. L. Wise.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 29-34, 3 ref.

Descriptors: *Legislation, *Clean Water Act, *Water quality control, *Toxicity, *Legislation, Water pollution control, Regulations.

Implementation of the Clean Water Act started with development of water pollution controls using the tools of engineering and mathematical modeling. As implementation of the act has evolved, however, the importance of toxic pollutants has come to be recognized, and that new and different methods, toxicological methods, to analyze toxic pollution and to set cost-effective toxic effluent controls are needed. To deal with this new challenge an approach for the regulation of toxic effluents has begun to be put together. Although a regulatory policy is now in place, implementation of that policy is just beginning. Little experience in using toxicological methods and tests for regulating effluents, is just available, yet this new regulatory approach must work. (See also W87-08624) (Lantz-PTT)
W87-08627

WATER QUALITY CRITERIA: PROTECTION OF USE PERSPECTIVE,
Environmental Protection Agency, Washington, DC. Office of Water Regulations and Standards.
For primary bibliographic entry see Field 5G.
W87-08629

SO2 OXIDATION IN CLOUD DROPS CONTAINING NACL OR SEA SALT AS CONDENSATION NUCLEI,
Nevada Univ. System, Reno. Desert Research Inst.
D. F. Miller, D. Lamb, and A. W. Gertler.
Atmospheric Environment ATENBP, Vol. 21, No. 4, p 991-993, April 1987. 1 fig, 1 tab, 13 ref. EPRI Contract RP 1434-3.

Descriptors: *Sulfur dioxide, *Sulfates, *Condensation nuclei, *Oxidation, *Clouds, Atmosphere, Sodium chloride, Sea salt.

Experimental results from cloud-chamber studies provide direct evidence that NaCl, artificial sea salt and natural sea salt promote faster rates of aqueous SO2 oxidation than observed in the absence of these salts. However, the chemical basis for this effect has not been clarified. Oxidation rates $> 30\%/h$ are observed in cloud-chamber experiments with 0.4 micron-diameter salt particles as cloud nuclei and a cloud pH of 6. SO2 oxidation under similar atmospheric conditions might account for the rapid formation of sulfate observed in marine fogs. (Author's abstract)
W87-08950

REGULATORY DILEMMAS ENSNARE ARIZONA'S SMALL WATER COMPANIES,
For primary bibliographic entry see Field 5F.
W87-08952

COMMITTEE REPORT: MICROBIOLOGICAL CONSIDERATIONS FOR DRINKING WATER REGULATION REVISIONS,
American Water Works Association, New York.
For primary bibliographic entry see Field 5F.
W87-08959

EFFECTIVE ALTERNATIVE TO OFFICIAL REGULATION OF INDIRECT ADDITIVES TO DRINKING WATER,
National Sanitation Foundation, Ann Arbor, MI.
For primary bibliographic entry see Field 5F.
W87-09120

WATER TREATMENT CHEMICALS CODEX,
National Research Council, Washington, DC. Food and Nutrition Board.
For primary bibliographic entry see Field 5F.
W87-09121

REGULATION OF CONTAMINANTS IN DRINKING WATER,
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
For primary bibliographic entry see Field 5F.
W87-09128

FEDERAL PROTECTION OF GROUNDWATER,
Kadison, Pfaelzer, Woodward, Quinn, and Rossi, Washington, DC.
For primary bibliographic entry see Field 5G.
W87-09129

WORLD HEALTH ORGANIZATION AND GUIDELINES AND EUROPEAN ECONOMIC COMMUNITY DIRECTIVES,
Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
J. R. Hickman, and B. Pharm.
IN: Safe Drinking Water: The Impact of Chemicals on a Limited Resource. Lewis Publishers, Chelsea, Michigan. 1985. p 201-208, 1 tab, 7 ref.

Descriptors: *Drinking water, *Water quality standards, *World Health Organization, *European Economic Community, *Water law, Water quality control, Regulations, Water pollution control, Water pollution effects, Public health, Consumptive use, Organic compounds, Organoleptic properties.

The World Health Organization's (WHO) new Guidelines for Drinking Water Quality and the Directive of the Council of the European Communities of July 15, 1980, relating to the quality of water intended for human consumption are discussed. The approach taken in the new Guidelines for Drinking Water Quality recognizes that the possibility for providing safe water varies greatly in different areas of the world. The WHO guideline values are intended to assist the appropriate agencies in different countries to develop standards for microbiological, biological, chemical, organoleptic and radiological parameters and, in developing countries, monitoring and surveillance activities. The European Community Directive of July 15, 1980, relating to the quality of water intended for human comsumption estblishes finite standards to be respected by Member States. There is a remarkable similarity between the WHO and EEC lists in terms of health-related inorganic substances that are included and the guideline values (WHO) and maximum admissible concentrations (EEC). The WHO guidelines are notable for the range of organic substances for which values have been set. These include a number of chloroalkenes and chloroalkanes, chlorophenols and chlorobenzenes. In contrast, the EEC standard has no maximum allowable concentration for organics other than pesticides. The WHO document lists values for 7 commonly occurring pesticides individually. The EEC document requires that not more than 0.1 microgram/liter of any individual pesticide be present with a total not exceeding 0.5 microgram/liter. Differences between the two documents are more noticeable among those parameters affecting the organoleptic and aesthetic qualities of water. (See also W87-09114) (Geiger-PTT)
W87-09130

REGULATORY FLEXIBILITY AND CONSUMER OPTIONS UNDER THE SAFE DRINKING WATER ACT,
Kadison, Pfaelzer, Woodward, Quinn, and Rossi, Washington, DC.
For primary bibliographic entry see Field 5F.
W87-09131

ECONOMIC, LEGAL, AND HYDROLOGIC DIMENSIONS OF POTENTIAL INTERSTATE WATER MARKETS,
Colorado Univ. at Boulder.
For primary bibliographic entry see Field 6C.
W87-09211

IRRIGATED AGRICULTURE AND GROUNDWATER QUALITY--A FRAMEWORK FOR POLICY DEVELOPMENT,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6A.
W87-09212

WETLANDS POLICY CRISIS: UNITED STATES AND UNITED KINGDOM,
Battelle Memorial Inst., Denver, CO. Dept. of Environmental Sciences.
R. W. Nelson.
Agriculture, Ecosystems and Environment, Vol. 18, No. 2, p 95-121, December 1986. 4 fig, 36 ref.

Descriptors: *Wetlands, *Public policy, *Agriculture, *Conservation, *Political constraints, *Reviews, England, Crop production, Grazing, Economic aspects, Regulations, Legislation, Taxes, Federal jurisdiction, Administrative issues.

A policy crisis exists in both the United States and the United Kingdom, resulting from contradictory incentives of the central government to both drain and preserve wetlands. This conflict is worsened by the emergence of a conservative political climate that opposes government regulation, particularly in remote rural environments and by massive budget deficits. The basis of the policy crisis and the dominant issues in the agricultural and conservation communities of both countries are delineated and compared. Issues that concern the farming sector include the level of financial returns available from preserving private wetlands, the level of government inducements to voluntary preservation, and the degree of government interference in rural or countryside land use. Issues focusing on the interests of the conservation sector include: government grants; subsidies and tax incentives that promote wetland conversions to agriculture; government arterial drainage schemes that create private wetland drainage opportunities; the level of commitment of public funds to wetlands protection; the mix of voluntary and compulsory measures for protection; and tailoring protection to the different kinds of wetlands or wetland activities. A general prescription for ameliorating the policy crisis is to eliminate the competition between drainage and preservation incentives of government agencies. (Doria-PTT)

W87-09215

ENVIRONMENTAL LEGISLATION,
Springborn Bionomics, Inc., Wareham, MA. Aquatic Toxicology Lab.
R. B. Foster.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 587-600, 5 tab, 31 ref.

Descriptors: *Toxicity, *Environmental law, *Legislation, *Aquatic toxicology, National Environmental Policy Act, Federal Insecticide Fungicide and Rodenticide Act, Federal Water Pollution Control Act, Marine Protection Research and Sanctuaries Act, Toxicity, Aquatic environment, Regularities.

Emergence in the early 1970s of the Federal Insecticde, Fungicide and Rodenticide Act (FIFRA), Federal Water Pollution Control Act (FWPCA), and Marine Protection Research and Sanctuaries Act (MPRSA) legislation created an immediate demand for reliable techniques for measuring biological response and burdened a small but capable group of government, industry, and academic laboratories with the responsibility for developing and validating these methods. The need created by regulatory demand undoubtedly strained a limited set of resources, but also made available many opportunities for evaluating the impact of pollutants on aquatic life. Inevitably, it was the regulation of all forms of potential environmental contamination that forced aquatic toxicology and the application of toxicity tests to evaluate environmental safety to experience the quantum leap to the prominence they hold today. Although there is little question that legislation accelerated the effort to develop and adopt standard procedures, these procedures may not always be suitable for addressing the array of questions that can arise in evaluating the hazard of a new pesticide, chemical, or industrial discharge. Continued improvement in the ability to predict the consequences of exposure to environmental contaminants is necessary if those charged with protecting the environment are to succeed. Improvements, however, require change, and change in the form of new and innovative approaches to assessing biological response can be discouraged by the regulatory bureaucracy with mechanistic demands for uniformity and standardization. Now that U.S. environmental legislation has been implemented which regulates all forms of environmental pollution it is time to reassess this approach and strive to provide a better vehicle for long-range research and development of new testing methodologies. The evolution of aquatic toxicology and its use in the hazard evaluation process during the next 10-15 yr will be contingent on this reassessment. (See also W87-09280) (Lantz-PTT)
W87-09299

ROMAN DAMS IN SOUTHERN PORTUGAL,
Technical Univ. of Lisbon (Portugal).
A. C. Quintela, J. L. Cardoso, and J. M. Mascarenhas.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 5, p 38-40, 70, May 1987. 3 fig, 4 tab, 5 ref.

Descriptors: *Dams, *Roman dams, *Portugal, *Archaeology, Surveys, History, Classification, Irrigation.

The results of the inventory and characterization of the Roman dams in southern Portugal are briefly presented. This study was based on bibliographical analysis inquiries, information provided by archaeologists and field surveys. Eight unknown Roman dams and ten others already mentioned in publications were recognized. A typological classification is presented here. (Author's abstract)
W87-09411

IXTOC I OIL SPILL - THE DAMAGE ASSESSMENT PROGRAM AND ECOLOGICAL IMPACT,
For primary bibliographic entry see Field 5C.
W87-09554

6G. Ecologic Impact Of Water Development

AQUATIC TOXICOLOGY AND HAZARD ASSESSMENT: EIGHTH SYMPOSIUM.
American Society for Testing Materials, Philadelphia, PA.
For primary bibliographic entry see Field 6E.
W87-08624

SCIENTIFIC CONSIDERATIONS IN THE LEGISLATIVE ARENA,
For primary bibliographic entry see Field 6E.
W87-08625

SCIENTIFIC CONSIDERATIONS IN THE INTERNATIONAL ARENA,
Unilever Research, Bebington (England). Port Sunlight Lab.
For primary bibliographic entry see Field 6E.
W87-08626

ECOLOGICAL CONSEQUENCES OF ARTIFICIAL CHANGES IN THE WATER REGIME OF LAKES AND THEIR SIGNIFICANCE FOR FORECASTING,
I. I. Nikolaev.
Soviet Journal of Ecology SJECAH, Vol. 17, No. 3, p 136-143, January 1987. 1 tab, 45 ref. Translated from Ekologiya, No. 3, p 27-35, May-June 1986.

Descriptors: *Limnology, *Lakes, *Water level fluctuations, Forecasting, Ecological effects, Flow.

The laws of ecological changes in lakes with artificial disruption of their water regime were examined in the following variations: (a) a drop in the average level of the water body; (b) a rise in the average level; (c) a change in the regime of levels (infra-annual rhythmicity and amplitude of variation); and (d) a change in the flow regime of the lake. Also shown are opportunities for utilizing the appropriate laws with the goal of ecological forecasting. (Author's abstract)
W87-08708

WATER USE OF EUCALYPTS - A REVIEW WITH SPECIAL REFERENCE TO SOUTH INDIA,
Institute of Hydrology, Wallingford (England).
I. R. Calder.
Agricultural Water Management AWMADF, Vol. 11, No. 3/4, p 333-342, September 1986. 1 tab, 35 ref.

Descriptors: *Eucalypts, *Plant water use, *Reviews, *India, Transpiration, Interception loss, Afforestation, Water table.

Current knowledge of the water use characteristics of eucalypts, in terms of transpiration and interception loss, is discussed within the context of the controversy concerning the possible deleterious effects of the present program of afforestation in South India. Although results from studies in other countries cannot be simply extrapolated to Southern India it is argued that only in exceptional circumstances, in particular those when Eucalyptus species which do not exhibit stomatal control are planted in areas where water tables are shallow, are the fears of 'voracious' water use likely to be justified. The form of research program required to assess fully the hydrological implications of this planting program is outlined. (Author's abstract)
W87-08749

GEOTHERMAL RESERVOIR ENGINEERING EXPERIENCE IN ICELAND,
Vatnaskil, Reykavik (Iceland).
S. P. Kjaran.
Nordic Hydrology NOHYBB, Vol. 17, No. 4/5, p 417-438, 1986. 34 fig, 1 tab, 21 ref.

Descriptors: *Geothermal studies, *Geothermal resources, *Ecological effects, *Engineering, *Geothermal power, Evaluation, Iceland, Engineering geology, Geophysics, Natural resources, Resources development, Ecology, Environmental effects.

Geothermal reservoir engineering studies have been carried out in Iceland for years concurrently with the utilization of the various geothermal fields. This is essential in order to understand the responses of the reservoirs to exploitation. The importance of geothermal energy has grown steadily in the past decades relative to other primary energy sources, providing at present about 40% of the total energy consumed in Iceland. The experience gained from exploiting Icelandic geothermal reservoirs is reviewed. The geological setting of the hydrothermal system is described as well as geophysical exploration methods. Several field examples are presented, demonstrating the effects that exploitation has on the geothermal reservoir's response. (Author's abstract)
W87-08830

VALUING WILDLIFE IN BENEFIT-COST ANALYSES: A CASE STUDY INVOLVING ENDANGERED SPECIES,
Maine Univ. at Orono. Dept. of Agricultural and Resource Economics.
For primary bibliographic entry see Field 6B.
W87-09032

EFFECTS ON FISHERIES OF NON-BIOTIC MODIFICATIONS OF THE ENVIRONMENT IN THE EAST-DANUBE RIVER AREA,
Galati Univ., 6200 Galati, Romania.
N. Bacalbasa-Dobrovici.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 13-27, 4 fig, 2 tab, 51 ref.

Descriptors: *Fisheries, *Water resources development, *Environmental effects, *Danube River, *Iron Gates Dam, *Romania, Rivers, Hydrological regime, Fish, Flood plains.

The lower Danube area, between the present Iron Gates I Dam and the mouth of the Danube in Romania, was extensively exploited for fisheries, which were adapted to the hydrology of the river and the ecology of the fish. This was the situation until the new period of intensive damming-up began in 1965. Before 1965, the hydraulic works carried out in the flood-plain of the Danube were mostly aimed at fisheries production, but later the campaign of damming-up began and more than 80% of the flood-plain and nearly one-quarter of the Delta was affected. The Iron Gates dam stopped the passage of fish in the middle Danube area and concomitantly there were profound changes to the hydraulic regime of the tributaries. There is an undoubted change in the fauna, especially the fish, and in the whole East-Danube fisheries. Plans for further multilateral economic development and exploitation of the East-Danube area will increase the problems for fisheries. For the present, adequate compensation for the reduction in catch is provided by the considerable area of ponds constructed in the dammed-up flood-plain and the Delta. (See also W87-09036) (Author's abstract)
W87-09038

FALL OF MIGRATORY FISH POPULATIONS AND CHANGES IN COMMERCIAL FISHERIES IN IMPOUNDED RIVERS IN POLAND,
Inland Fisheries Inst., Zabiniec, 05-500 Piaseczno, Poland.
T. Backiel.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 28-41, 4 fig, 4 tab, 28 ref.

Descriptors: *Fish populations, *Water resources development, *Environmental effects, *Reservoirs, *Poland, *Vistula River, River basins, Biomass, Fish, Hydrological regime, Stream fisheries.

The histories of fisheries for migratory fish in the Vistula river and of fisheries in 12 reservoirs are summarized. River basin developments are believed to be responsible for the decline of anadromous fish and for changes in fish communities. Succession in the communities is similar to that observed in eutrophic lakes. It would be unfair to blame dams for the loss of species diversity without even mentioning the increase of total fish biomass. This increase is roughly proportional to the areas inundated after damming. Considering particular stretches of impounded rivers, the new water bodies are up to 100-fold larger than the old river beds. However, the balance of losses and benefits to fisheries can easily be made only for a particular area, while appraisal of changes in the whole river system with respect to fisheries may depend on the preferences of interested parties. From the examples summarized, one can infer that there are starting points for such appraisals. Changes in fish communities are predictable and so are changes in fish biomass. However, predictions of the changes during the first years after damming a river can fail with regard to the development of local populations since in new, unenclosed waters, chance introductions (or invasions) can occur. But later on, whatever the initial fish community and conditions in reservoirs, the 'climax' community tends to be similar. The next conclusion would be that it seems neither necessary nor feasible to implement modifications in the hydrological regime of reservoirs since, even if possible, they would result only in retardation or acceleration of existing general trends. The value of fish-passes is debatable. Even with a good design the dam remains an obstacle to the free movement of fish and cannot fully simulate the open river channel. It may be inferred that resisting the natural succession in fish communities induced by river-basin development is rather unsuccessful. Here, any stocking operation should be carefully considered in the light of the likely natural development of fish communities. This question requires much more detailed evidence than it has been possible to present here, and offers scope for further research. (See also W87-09036) (Lantz-PTT)
W87-09039

EFFECTS OF IMPOUNDMENT AND REGULATION OF THE RIVER TEES AT COW GREEN (NORTHERN PENNINES, UK) UPON FISH POPULATIONS IN AFFERENT TRIBUTARIES AND IN THE RIVER IMMEDIATELY DOWNSTREAM OF THE DAM,
Freshwater Biological Assoc., c/o Northumberland Water Authority, Lartington Treatment Plant, Barnard Castle, County Durham, DL129DW, UK.
D. T. Crisp.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 42-51, 5 fig, 1 tab, 9 ref.

Descriptors: *Reservoirs, *River Tees, *Fish populations, *Water resources development, *Environmental effects, Dams, Trout, Bullheads, Rivers, Seasonal variation.

The Cow Green river-regulating reservoir was completed in 1970; it has an area, when full, of 312 ha and an altitude of 489 m. Preimpoundment fish studies were made from 1967 to 1970 and postimpoundment studies are continuing. This chapter deals with populations of brown trout (Salmo trutta) and bullhead (Cottus gobio). 'Before-and-after' comparisons of growth, age composition, survival, population density, fecundity and movements of the two fish species were made in the river downstream of the dam and in the tributaries flowing into the reservoir. There was no artificial stocking of trout. In the river downstream of the dam, the population density of the bullhead increased by 200% and that of trout by about 40%, following regulation. Neither species showed a substantial change in growth rate. In the afferent streams after impoundment there was an upstream extension of distribution of the bullhead, with some evidence of seasonal movements between reservoir and streams. In the more 'flashy' afferent streams the population density of trout of age groups 0 and I increased. The implications and possible mechanisms of some of the observed changes are briefly discussed. (See also W87-09036) (Author's abstract)
W87-09040

REPURCUSSION OF SMALL HYDROELECTRIC POWER STATIONS ON POPULATIONS OF BROWN TROUT (SALMO TRUTTA) IN RIVERS IN THE FRENCH MASSIF-CENTRAL,
Conseil Superieur de la Peche, Delegation Regionale Auvergne-Limousin, 84 Avenue du Puy-de-Dome, 6300 Clermont-Ferrand, France.
J.-J. Demars.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 52-61, 4 fig, 2 tab, 2 ref.

Descriptors: *Trout, *Hydroelectric power, *Environmental effects, Rivers, Seasonal variation, Fish populations, Discharge frequency, Dams.

An overall description is given of 10 small hydroelectric stations situated in a medium-altitude mountain zone. The populations of the main fish species (Salmo trutta) were assessed by electric fishing at each of the 10 sites. Comparisons are made between the stocks in a sector of river from which water is abstracted for the power station, and those in a sector not so affected. Correlations are given between the apparent status of the stock in the diverted sector as compared with the control sector, the volume of water abstracted for the station, and the discharge reserved for the river. The results suggest the fixing of the reserved discharge as a percentage of the mean annual flow, bearing in mind the size of the station in question. Under these conditions, and while maintaining the seasonal water levels, the values of the reserved discharges for spring and summer should be 20% greater than the mean annual value within the limit of the natural yield; those for autumn and winter would be between 10 and 15% of the annual average flow, given that as a result of the overflows from the dam the residual discharge would be greater, depending on the circumstances. (See also W87-09036) (Lantz-PTT)
W87-09041

ADVERSE EFFECTS OF CHANNELIZATION AND THEIR AMELIORATION,
Department of Fisheries and Forestry, Abbotstown, Castleknock (Ireland). Fishery Research Centre.
D. T. McCarthy.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 83-97, 155 ref.

Descriptors: *Channeling, *Water resources development, *Environmental effects, *Fisheries, Rivers, Marshes, Swamps, Flood basins, Fish populations, Regulations.

Published data on the physical, chemical and biological effects of channelization on rivers, marshes, swamps and floodbasins are reviewed, with particular emphasis on the effects of channelization on fisheries. A summary of the negative and positive effects on fisheries is given and remedial measures, which may partially or fully restore degraded habitats and help in the recovery of fish stocks, are also discussed. A code of practice and environmental criteria for channelization projects within EIFAC member states are recommended; these require the performance of pre- and post-channelization environmental impact statements (EISs). Additional field and desk studies are required on the methodologies employed in EISs in order to select those most appropriate for channelization projects. It is recommended that a manual for those involved in channel works should be produced and disseminated. (See also W87-09036) (Author's abstract)
W87-09043

DREDGING OF RAPIDS FOR TIMBER-FLOATING IN FINLAND AND ITS EFFECTS ON RIVER-SPAWNING FISH STOCKS,
Finnish Game and Fisheries Research Inst., Helsinki (Finland).
E. Jutila.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 104-108, 1 tab, 7 ref.

Descriptors: *Dredging, *Environmental effects, *Rivers, *Fish populations, *Finland, *Simojoki River, *Oulujoki River, Stream fisheries, Whitefish, Trout, Grayling, Salmon, Spawning.

Until the 1960s almost all the rivers in northern and eastern Finland were dredged, either by manpower or by bulldozers, for timber-floating. Dredging has altered the natural structure of the river-bed by removing the coarser bottom material and by changing the water flow in the rapids. Thus it has caused by extensive damage in the spawning areas of fish, especially salmonids. In the River Simojoki, the mean population densities of salmon parr were 1-4 parr/100 sq m in the dredged rapids and 6-9 parr/100 sq m in the natural areas. This resulted in a loss of 10,000 - 20,000 kg in the annual salmon catches. In tributaries of the River Oulujoki water system severe damage from dredging was caused to river-spawning whitefish, trout, grayling and ide stocks. Now timber-floating has ceased in most of the rivers. Since the latter half of the 1970s restoration works have been carried out in almost 20 rivers in order to restore conditions for natural reproduction in the dredged rapids. In the future, a large-scale program is needed for the restoration and management of dredged rivers and their fish stocks. (See also W87-09036) (Author's abstract)
W87-09045

AMELIORATIVE METHODS TO REINSTATE FISHERIES FOLLOWING LAND DRAINAGE OPERATIONS,
Thames Water Authority, Nugent House, Vastern Road, Reading, Berkshire RG18DB, UK.
P. B. Spillett, G. S. Armstrong, and P. A. G. Magrath.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 124-130, 3 fig, 1 tab, 8 ref.

Descriptors: *Fisheries, *Engineering, *Drainage, *Environmental effects, *Thames River, *England, *Oak River, *Cole River, Fish populations, Channels, Clays, Limestone, Macrophytes, Dredging, Fish stocking.

The deleterious effects of land drainage operations on fish populations are well known. This applies both to major engineering schemes and to routine maintenance work. Less well documented are remedial methods designed to reinstate fish populations are discussed. Three experimental studies are described on Thames tributaries with a clay substrate - a particularly difficult medium to rehabilitate. On the River Ock, crushed limestone and flint gravels were used to encourage invertebrate and macrophyte recolonization. Quantitative studies showed that the limestone substrate supported a higher density of invertebrates, exhibited a higher biological quality, and was recolonized faster than the bare clay. Routine maintenance dredging on the River Thame reduced the standing crop of chub and roach between 31 and 64%. Preparatory work and maintenance trimming also caused a decline by affecting in-stream and bankside cover. Experimental wooden hurdles were installed to assess their effect on enhancing and fish population. Eight years after engineering work on the River Cole, fish biomasses in some sections are less than 10% of their pre-scheme levels. Stone gabion weirs, groynes and deflectors have been installed to accelerate the recovery rate. (See also W87-09036) (Author's abstract)
W87-09048

EFFECT OF HABITAT MODIFICATION ON FRESHWATER FISHERIES IN LOWLAND AREAS OF EASTERN ENGLAND,
Anglian Water Authority, Ambury Road, Huntingdon, Cambridgeshire PE186NZ, UK.
For primary bibliographic entry see Field 2H.
W87-09050

EFFECTS ON SALMONID POPULATIONS OF ISOLATION OF A LAKE FROM A RIVER SYSTEM,
Central Electricity Generating Board, Llandegai Industrial Estate, Bangor, Gwynedd LL574YH, UK. Biology Lab.
A. Rogers, and A. Cane.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 159-164, 2 fig, 2 tab, 7 ref.

Descriptors: *Salmon, *Seiont River, *Wales, *Water resources development, *Environmental effects, Powerplants, Trout, Fish populations, Char, Fisheries, Spawning.

Changes in the hydrology of the upper Seiont river system, North Wales, consequent upon the construction and operation of the Dinorwic Pumped Storage power station, have resulted in loss of salmonid spawning and rearing areas above a diversion tunnel which effectively isolates Llyn Peris. Loss has been limited to a few small areas of river infilled or altered. Salmon and trout are shown to have negotiated the 2.2 km tunnel, despite complete darkness and very low water velocity, and to have spawned successfully upstream. Upon isolation of Llyn Peris, the Arctic char population of the Llanberis lakes was restricted to Llyn Padarn only, which has not been affected by the scheme. However, former migration routes have been affected, and so monitoring of the char has continued. They now use the modified Afon-y-Bala (between the two lakes) for spawning. There are indications of increase in number and mean size of adults, and investigations are continuing. (See also W87-09036) (Author's abstract)
W87-09051

WHITEFISH AND VENDACE STOCKS IN THE REGULATED LAKE PYHAJARVI, CENTRAL FINLAND,
Jyvaskyla, SF-40100 Jyvaskyla 10 (Finland). Environment Research Centre.
For primary bibliographic entry see Field 2H.
W87-09052

WATER LEVEL REGULATION OF LAKE INARI: IMPACTS AND COMPENSATION MEASURES,
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 2H.
W87-09053

DEVELOPMENT OF FISH STOCK AND FISH POPULATIONS IN LAKE INARI,
Finnish Game and Fisheries Research Inst., Inari (Finland). Fisheries Div.
For primary bibliographic entry see Field 2H.
W87-09054

FOOD OF WHITEFISH (COREGONUS LAVARETUS) IN TWO NEIGHBOURING LAKES, ONE REGULATED AND THE OTHER NATURAL,
Finnish Game and Fisheries Research Inst., Helsinki (Finland).
For primary bibliographic entry see Field 2H.
W87-09055

EFFECT OF RECREATIONAL USES UPON AQUATIC ECOSYSTEMS AND FISH RESOURCES,
Inland Fisheries Inst., Bloc 5, 10-957, Olstyn-Kortowo (Poland).
M. Bninska.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 223-235, 3 fig, 32 ref, 2 append.

Descriptors: *Aquatic ecosystems, *Recreation, *Ecological effects, *Fish populations, *Poland, *Model studies, Eutrophication, Nitrogen, Phosphorus, Fish management.

Recreational uses of aquatic ecosystems have now become a dangerous factor disturbing lake ecosystems and their fishery management. A tentative model is presented and discussed concerning recreational impact on three basic elements of the lake ecosystem: (1) the shore zone, (2) the water body (water habitat), and (3) the fish resources. The scale of impact, its intensity and levels of recreational loading are presented for Polish lakes. Special attention is given to lake eutrophication induced by the recreational uses of aquatic ecosystems, and the resulting regular change in the fish resources. A method of calculating recreational loading of lakes, expressed in phosphorus and nitrogen is presented, with special reference to the practical value of the results, using Vollenweider's criteria. Conclusions are drawn about feasible methods of lake protection, and a general outline of fishery management in lakes used for recreation is presented. (See also W87-09036) (Author's abstract)
W87-09060

SETTLEMENT, SUBSISTENCE, AND SPECIALIZATION IN THE NORTHERN PERIPHERY: RESEARCH DESIGN FOR MITIGATIVE DATA RECOVERY AT SITES IN THE NEW WADDELL DAM BORROW AREAS,
Archaeological Consulting Services, Ltd.
M. Green.
Available from the National Technical Information Service, Springfield, Virginia, 22161. Cultural Resources Report No. 40, 1986. 54 p, 5 fig, 8 tab, 98 ref. Bureau of Reclamation Contract No. 6-CS-30-04250.

Descriptors: *Archaeology, *New Waddell Dam, Social impact, Surveys, History, Hohokam, Drainage, Water level.

The Bureau of Reclamation contracted with Archaeological Consulting Services to perform mitigative data recovery at 17 sites in the Agua Fria and New River Borrow Areas in preparation for construction of New Waddell Dam. The contract also calls for supplemental survey in the vicinity and data recovery at significant sites in the newly defined survey areas. The Waddell area is considered part of the Hohokam northern periphery. Cultural resources in the area consist mainly of small field house sites or farmsteads and associated agricultural systems that may reach a square kilometer in area. The research proposed will be conducted at three levels: intra-drainage adaptations, inter-drainage relations and inter-regional interaction. At the first level, site contemporaneity and function will be assessed. The interface between sites and the natural environment and relationships among the sites themselves will be investigated. Comparisons in adaptations between the two different drainage situations and interaction between populations within them will be the focus of the inter-drainage level analyses. At the inter-regional level, ties between these northern periphery sites and both the Hohokam core and northern Arizona will be investigated. (See also W87-09067) (Author's abstract)
W87-09094

HISTORY OF THE CARLSBAD BASIN, SOUTHEASTERN NEW MEXICO,
Incarnate Word Coll., San Antonio, TX.
S. R. Katz, P. Katz, K. S. Jolly and, and S. McCord.
Available from the National Technical Information Service, Springfield, Virginia, 22161. November 1985. 221 p, 43 fig, 16 tab, 50 ref, append. Bureau of Reclamation Contract No. 3-CS-57-01690.

Descriptors: *Archaeology, *History, *New Mexico, *Water resources development, *Brantley Dam, Irrigation, Agriculture.

This volume describes the results of historical archaeological investigations and documentary research of the Brantley Dam and Reservoir Project locality, New Mexico. The two types of research, archaeological and historical, complement each other. A narrative of the history of this southeastern New Mexico locality begins with the 16th century and runs through the purchase of the land by the federal government in 1905. The Spanish traveled through the project area, but did not settle there. The territory remained in Apache control until the 19th century. Sheepherders, farmers, and cattlemen settled the area late in the 19th century. It was irrigation agriculture, however, that provided the base for increased population and economic development. Archaeological sites investigated provide data pertaining to the late 19th and early 20th century settlement and economic activities. (Author's abstract)
W87-09151

PREVENTING DESERT MULE DEER DROWNINGS IN THE MOHAWK CANAL, ARIZONA,
Arizona Univ., Tucson. School of Renewable Natural Resources.
K. R. Rautenstrauch, and P. R. Krausman.
Available from the National Technical Information Service, Springfield, Virginia, 22161 as PB87-160677, A06 in paper copy, A01 in microfiche. 1986. 96 p, 16 fig, 16 tab, 45 ref, append.

Descriptors: *Deer, *Drowning, *Mohawk Canal, *Arizona, *Water resources development, Canals, Ecological effects, Monitoring, Seasonal variation.

There are about 21 concrete-lined canals in the western U.S. and Canada in which hundreds of ungulates, primarily mule deer (Odocoileus hemoinus), have drowned. Concrete-lined canals are hazards to ungulates because canals disrupt movements and are an attractive nuisance. Bridges, fences, and alternate water sources have been built to prevent deer from entering canals, and many types of steps, ramps, and directional devices have been built to allow entrapped deer to escape from canals. From June 1982 through October 1985 desert mule deer (O. h. crooki) were monitored, and their activity along a 15 km study section of the Mohawk Canal, southwest Arizona, and escape steps and ramps with deflector cables and alternative water sources built to reduce deer drownings in the canal, were investigated. As many as 67 deer have drowned in this canal in one year, most during the summer dry season and winter droughts. The study section was checked 478 times and 5,307 deer-canal interactions (DCI) were recorded. Ninety-eight percent of the DCI were recorded from April through September; there were no winter droughts during this study. Deer approached this canal to drink, not to cross. Deer fell in the canal > or = 29 times: 116 escaped via steps, 79 via ramps, and 50 escaped unaided. Only 5 deer drowned in sections of the Mohawk canal with escape structures; 7 deer and 2 bighorn sheep (Ovis canadensis) drowned in sections without escape structures. The existing escape structures are adequately designed and spaced to prevent most summer mortalities. Deer use of the 2 water catchments increased significantly each year. Each time a deer drank from these catchments was one less opportunity for a deer to fall in the canal. The home ranges of 21 radio-collared deer were larger than any other mule deer population studied. Any catchment < or = 50 km from this canal can reduce the number of deer using the Mohawk Canal. Based on this information, the following recommendations can be made: maintain depths to water of < or = 30 cm, install cable directors at all escape structures, construct additional escape structures spaced < or = 2 km apart in the Texas Hill Canal, clean and maintain escape structures regularly, closely monitor the Mohawk canal during winter droughts, and build any additional water catchments > 8-10 km north of the canal. (Lantz-PTT)
W87-09152

PECOS PAST: THE PREHISTORY AND HISTORY OF THE BRANTLEY PROJECT LOCALITY,

Incarnate Word Coll., San Antonio, TX.
S. R. Katz, and P. Katz.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as PB87-139788, A06 in paper copy, A01 in microfiche. November 1985. 99 p, 28 fig, 62 ref. Bureau of Reclamation Contract No. 3-CS-57-01690.

Descriptors: *Brantley Dam, *New Mexico, *Water resources development, *History, Archaeology, Irrigation, Agriculture, Surveys.

The Brantley Archaeological Project is the latest component in the comprehensive study of the cultural resources of the Brantley Dam and Reservoir locality on the Pecos River in southeastern New Mexico. A summary of the environment, both past and present, the nature of archaeological investigations, and a cultural history of the area are presented. The cultural history begins with the Paleo-Indian Period (10,000 -6,000 B.C.) and ends with the sale of the Pecos Irrigation Company's system to the United States of America in 1905. Development of a local phase sequence for the prehistoric periods was a primary objective of this project, and the discussion of prehistory is organized by that sequence. In the historic period, special attention is given to the town of Seven Rivers, a 'ghost town' that flourished in the project area during the latter part of the nineteenth century. Also, the history of the early irrigation works, and the development of the city of Carlsbad, New Mexico, are discussed. (Author's abstract)
W87-09155

PREHISTORY OF THE CARLSBAD BASIN, SOUTHEASTERN NEW MEXICO,
Incarnate Word Coll., San Antonio, TX.
S. R. Katz, and P. Katz.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as PB87-139366, A99 in paper copy, A01 in microfiche. November 1985. 591 p, 95 fig, 34 tab, 150 ref, 8 append. BuRec Contract 3-CS-57-01690.

Descriptors: *Brantley Dam, *Pecos River, *New Mexico, *Archaeology, History, River basins, Surveys.

Cultural resources investigations were conducted for the Bureau of Reclamation in the Brantley Dam and Reservoir Project area during 1983 and 1984. The primary objective of the research was the development of a local phase sequence for the project area, situated along the Pecos River in Eddy County, New Mexico. Twenty archaeological sites with prehistoric components were tested, employing a variety of strategies which included small test squares, machine-dug trenches, and block excavation units. Sites were selected which appeared to be well preserved, stratified, situated in different topographic zones, and which exhibited either multiple feature types or examples of unique features or activities. Reconnaissance of portions of the project area completed an inventory begun by Southern Methodist University in 1974. Forty-three prehistoric sites were recorded. Other objectives, all successfully achieved, included a reconstruction of the project area paleoenvironment, geoarchaeological investigation of the Lakewood Terrace, determination of site function, documentation of Apachean presence, and the investigation of burned rock features. A local phase sequence is presented, which includes three Archaic, three Late Prehistoric, and one Ethnohistoric period phases. Occupation of the project area begins about 5,000 years ago during the Middle Archaic and continues uninterrupted into the Ethnohistoric period. A great deal of new data is provided about open-air Archaic sites, the transition from an Archaic to a Late Prehistoric lifeway, and the relationships between topographic zones within the project area and between the Brantley locality and adjacent localities. (Author's abstract)
W87-09156

REPORT ON ADDITIONAL HUMAN SKELETAL MATERIAL EXPOSED BY RESERVOIR INDUCED EROSION AT LAKE ALTUS, SOUTHWESTERN OKLAHOMA,
Bureau of Reclamation, Amarillo, TX.
V. T. Button, and G. Agogino.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as PB87 136784, A03 in paper copy, A01 in microfiche. September 1986. 36 p, 2 fig, 2 tab, 10 ref, 2 append.

Descriptors: *Reservoirs, *Lake Altus, *Oklahoma, *Archaeology, Erosion, Burial sites, Radioactive dating, History.

Sites 34Gr5 and 34Gr6 are located below the shoreline of modern Lake Altus in southwestern Oklahoma. The sites are a complex of archaeological deposits on either side of a tributary drainage cutting the first major alluvial terrace on the west side of the North Fork of the Red River. A dense carpet of burnt rock and broken grinding tools covers a 1-acre of the south side of the drainage (34Gr5) and 7 acres of the north side (34Gr6). Lake Altus, a component of the Bureau of Reclamation's (Reclamation) W. C. Austin Irrigation and Water Storage Project, was constructed in 1946. When the lake is full, the sites lie below 15 to 20 feet of water. However, annual irrigation drawdowns result in near constant exposure of portions of the sites. In 1985, local drought conditions caused the sites' eastern edges to be exposed for the first time since 1949. This report is occassioned by the discovery of human skeletal material at 6 separate locations and seventh location of an apparent cultural feature along the rarely exposed easternmost edges of the sites. Results of the recovery of elements of 13 human burials are described. The burials were exposed at the eastern edges of sites 34Gr5 and 6 by extreme reservoir drawdown at Lake Altus in September 1985. A multiple burial of three to five individuals is represented. All other individuals were recovered from displaced contexts. A formal description of the skeletal material is presented. Radiocarbon dates were obtained for the multiple burial (1,270 + or- 90 B.P.) and one of the surface finds (1,390 + or - 90 B.P.). (Lantz-PTT)
W87-09161

ELLISFORD CREMATIONS: INTERNECINE HOSTILITIES IN THE 5TH CENTURY A.D.,
Central Washington Univ., Ellensburg.
J. C. Chatters.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as PB87 139796, A04 in paper copy, A01 in microfiche. Archaeological Report 86-1, 1986. 59 p, 14 fig, 20 ref, 3 append.

Descriptors: *Ellisford, *Washington, *Archaeology, Water resources development, Irrigation, Surveys, History.

Trenching for an irrigation line near the town of Ellisford, personnel of the Oroville-Tonasket Irrigation District uncovered human remains. Burial recovery by Central Washington Archaeological Survey revealed hundreds of charred bone fragments representing five Native-Americans. The two men, young woman, and two young children had been ceremonially cremated and the residue scraped into a single common grave. One man and the woman had died from arrow wounds and the man had suffered such wounds on a previous occasion. Cause of death could not be determined from what remained of the other skeletons, but homicide is assumed from the simultaneity of the interments. This killing of five persons of both sexes and various ages occurred around 425 A.D., and is taken as evidence for Internecine hostilities that seem to have begun at least as early as the advent of Plateau Culture. (Author's abstract)
W87-09162

PREHISTORIC HUNTER-GATHERERS OF SOUTH CENTRAL ARIZONA: THE PICACHO RESERVOIR ARCHAIC PROJECT,
Arizona State Univ., Tempe. Office of Cultural Resource Management.
F. E. Bayham, D. H. Morris, and M. S. Shackley.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as PB87 157301, A22 in paper copy, A01 in microfiche. Anthropological Field Studies Number 13, 1986. 527 p, 96 fig, 64 tab, 351 ref, 9 append.

Descriptors: *Yakima River, *History, *Archaeology, Surveys, River basins, Environmental effects, Irrigation, Water resources development.

Published literature, archival and documentary sources were examined to provide planning information for the Yakima River Basin Water Enhancement Project in central Washington. The overview summarized the basin's history and defines the major historical themes for evaluating the significance of sites dating from approximately A.D. 1800. Seven potential reservoirs and proposed irrigation developments on the Yakima Indian Reservation are then examined in detail to provide a preliminary assessment of impacts to historical sites. The report concludes with a series of recommendations regarding the significance of individual sites and suggested future study needs. (Author's abstract)
W87-09191

YAKIMA RIVER BASIN HISTORICAL RESOURCE SURVEY, VOLUME I: OVERVIEW AND MANAGEMENT RECOMMENDATIONS,
Heritage Research Center, Missoula, MT.
W. A. Babcock, T. E. Eckert, and G. D. Williams.
Available from the National Technical Information Service, Springfield, Virginia, 22161. December 1986. 353 p, 140 fig, 155 ref. Bureau of Reclamation Contract No. 5-PG-10-12200.

Descriptors: *Archaeology, *Hohokam, *Arizona, *Geochemistry, Surveys, Wetlands, Environmental effects.

The Picacho Archaic Project investigated a series of localities, sites, and quarries in the area of the Picacho Reservoir in southern Arizona. These remains date principally to the Archaic period of the American southwest, although some of the sites and the three quarries were also used during the following ceramic period. Supported by detailed geomorphological studies and environmental reconstruction, obsidian geochemical analysis, and quantitative artifactual analyses, this study demonstrates that the use of this portion of the Sonoran desert was conditioned by shifts in rainfall patterns and the level of group mobility. The research also found that more than one Archaic group made use of seasonally availability wetlands in the Picacho sand dunes, but in quite different ways. The spatial distinctiveness of the camps ringing the prehistoric wetlands allows the researchers to measure the variation in mobility strategies used by each group. The study also discusses the multiple factors influencing the morphology of projectile points and lithic assemblage variability, and relates these factors to the evidence for high levels of mobility and group interaction during the Archaic period. The project was funded by the Bureau of Reclamation as part of the construction of the Central Arizona Project Canal, and was conducted through Arizona State University. (Author's abstract)
W87-09192

MAN-INDUCED GRADIENT ADJUSTMENT OF THE SOUTH FORK FORKED DEER RIVER, WEST TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
A. Simon, and C. H. Robbins.
Environmental Geology and Water Sciences EGWSEI, Vol. 9, No. 2, p 109-118, 1987. 7 fig, 1 tab, 16 ref.

Descriptors: *Channel improvement, *Tennessee, *Ecological effects, *Channeling, *Tributaries, *Stream degradation,, *Aggradation, Aggrading rivers, Energy, Sediments, Sedimentation, Equilibrium, Mathematical equations, Mathematical analysis.

Channel modifications from 1968 to 1969 on the South Fork Forked Deer River in western Tennessee have caused upstream degradation, downstream aggradation, and bank failures along the altered channels, adjacent reaches, and tributaries. The result of these adjustments is a general decrease in gradient as the channel attempts to absorb the imposed increase in energy conditions created by channelization. Gradient adjustment with time

is described by exponential decay functions. The length of time required for adjustment to some new quasi-equilibrium condition is computed by these decay functions and is about 20 years from the completion of channel work. Adjusted slopes are less than pre-disturbed values, probably because straightened channels dissipate less energy by friction, allowing more energy for sediment transport. An equivalent sediment load, therefore, can be transported at a considerably gentler slope. The pre-disturbed slope exceeds the adjusted slope by an order of magnitude on the downstream reach of the South Fork Forked Deer River. (Author's abstract)
W87-09206

DROWNING OF A CULTURE,
J. Mohun, and O. Sattaur.
New Scientist NWSCAL, Vol. 113, No. 1543, p 37-42, January 1987.

Descriptors: *Dam effects, *Environmental effects, *Ecological effects, Erosion, Human population, Planning, Hydroelectric plants, Industrial development, Resources development.

The Bakun Hydroelectric Project in Sarawak, the largest dam in southeast Asia, will hold 4000 cubic meters of water and displace about 4300 people. Nine feasibility studies have been made but the information has not been made public. The dam will be 210 m high and create a 695 sq km lake, while providing 2400 MWe of electricity. Sarawak needed only 180 MWe in 1985 and may use 580 MWe by 1990. The surplus will be channeled 650 km to the Malay Peninsula via 2 high-voltage DC cables, each carrying 750 MWe, across the floor of the China Sea. The dam will flood 15 settlements and potentially power an aluminum smelting plant proposed by Reynolds Aluminum. The dam will take 12.5 years to construct and employ 3390 people. (McFarlane-PTT)
W87-09231

TUCSON AQUEDUCT PHASE B CENTRAL ARIZONA PROJECT: ARCHAEOLOGICAL DATA RECOVERY STUDIES, 1985-1986 ANNUAL REPORT,
Arizona State Museum, Tucson.
J. S. Czaplicki.
February 1987. 45 p, 12 fig, 8 tab, 18 ref. Bureau of Reclamation Contract No. 6-CS-30-03500.

Descriptors: *Tucson Aqueduct, *Arizona, *Archaeology, Hohokam, Water resources development, History, Survey.

Arizona State Museum's 1985-1986 Annual Report is a summary of the fieldwork and activities during the first contract year of the Tucson Aqueduct - Phase B, Mitigative Data Recovery Study in the Avra Valley. Management information and research results of the 15 Hohokam sites investigated are presented in this report. These include ceramics, chipped and ground stone, flotation, pollen, bone, shell, faunal, archaeomagnetic and carbon-14 dating, human cremation and inhumation remains, and geomorphological assessment. The turquoise sourcing study and wood charcoal identification have yet to get underway. Ceramic and ground stone analyses are completed, and draft reports are currently being written. The ceramic analysis currently available is descriptive; more detailed studies are still planned, but details have yet to be developed. Other aspects of the analyses, such as site organization, architecture, burials, and regional exchange, are in various stages of development. The plan of work for 1986-1987 involving fieldwork, analyses, report preparation and miscellaneous projects are also discussed in the annual report. (Lantz-PTT)
W87-09329

DOLORES ARCHAEOLOGICAL PROGRAM: ANASAZI COMMUNITIES AT DOLORES: EARLY ANASAZI SITES IN THE SAGEHEN FLATS AREA,
Dolores Archaeological Program, CO.
A. E. Kane, and G. T. Gross.
July 1986. 985 p, 395 fig, 136 tab, 614 ref, 63 append. Bureau of Reclamation Contract No. 8-07-40-S0562.

Descriptors: *Dolores Project, *Colorado, *Archaeology, *Anasazi, History, Water resources development, Surveys.

During the 1979 field season, 9 sites were excavated. This was to provide information about the Sagehen Flats Locality during the Sagehen Phase. Investigation revealed 5 were limited activity sites and 4 were hamlets. Tres Bobos, Site 5MT4545, is a Basketmaker III habitation. Excavations discovered 1 pithouse and 14 surface rooms. Tres Bobos was occupied between A.D. 600-850. Apricot Hamlet, Site 5MT2858, is a multiple occupation Basketmaker III/Pueblo I site. Excavations revealed a pithouse and a pithouse and a pit structure. The site was occupied between A.D. 625 and 680, and reoccupied between A.D. 750 and 800. Aldea Sierritas (Site 5MT2854) is an Anasazi hamlet. Investigation revealed 2 pithouses and 3 surface rooms. This occupation has been assigned to the transition between the Tres Bobos and Sagehill III Subphases. Prairie Dog Hamlet, Site 5MT4614, dated to the late Basketmaker III-early Pueblo I periods. The site had 2 occupations (A.D. 600-760). Casa Bodega Hamlet (Site fM%2194) is a Pueblo I habitation site. Excavations revealed a single household cluster consisting of a pithouse, 3 storage facilities, a work area, and a trash area. The ceramic data places occupation between A.D. 775 and 850. Dos Casas Hamlet (Site 5MT2193) is a Basketmaker III/Pueblo I site. Investigations recorded 2 pithouses, surface rooms, and occupation areas. Pithouse I was constructed around A.D. 760 nd Pithouse 2 was constructed approximately 10 years later. Windy Wheat Hamlet (Site 5MT4644) is a Pueblo I site. Three elements, occurring between A.D. 740 and the early 800's, were recognized. Cascade House (Site 5MT4512) is a Pueblo I field house. A pithouse and pitroom and 2 masonry/jacal storage rooms were excavated. Cascade House appears to have been occupied during the ninth century A.D. Casa Roc, Site 5MT2203, is a seasonal, single-component site assigned to the McPhee Phase (A.D. 850-970). (Author's abstract)
W87-09330

CULTURAL RESOURCE INVENTORY OF FRESNO RESERVOIR, HILL COUNTY, MONTANA,
Ethnoscience, Billings, MT.
K. Deaver.
January 1987. 109 p, 13 fig, 9 tab, 84 ref, append.

Descriptors: *Fresno Reservoir, *Montana, *Archaeology, History, Prairies, Environmental resources, Cairns, Water resources development.

A cultural resource survey was conducted of 20,234 acres around Fresno Reservoir in north central Montana. The survey area is in an open prairie setting and sites reflect an intense specialization on open prairie resources. A large number of sites with an enormous number of stone features were found. When data from this survey are combined with previous work, over 400 sites with nearly 10,000 features have been reported on 28,681 acres. This is the highest feature density yet reported and is 4-10 times the normal feature densities in northern Montana. The Fresno area appears to have a preferred location during the last 3000 years. All sites in the area point to year round occupation, upland living in tipis, and intensive utilization of upland resources particularly communal bison hunting. The Fresno area is a unique concentration of sites and also contains a number of unusual feature types, particularly medicine wheels, vision quest structures and unusual rings and cairns. The area's sites have unique values but also contain substantial redundancy. (Author's abstract)
W87-09331

PREHISTORIC CULTURAL RESOURCES STUDY PREDICTIVE MODEL AND FIELD SURVEY WEBER BASIN PROJECT,
American Archaeological Consultants, Inc. Fair Oaks, CA.
R. S. Levy, and C. A. Ebright.
Report of Investigations No. 5, January 6, 1987. 79 p, 13 fig, 15 tab, 14 ref. Bureau of Reclamation Contract No. 6-CS-40-03740.

Descriptors: *Weber Basin, *Model studies, *Provo River, *Utah, *Archaeology, *Water resources development, Surveys, Irrigation.

This study assesses the impacts of the Weber Basin Project on prehistoric cultural resources resulting from the conversion of between 20,000 and 40,000 acre-feet of water per year from irrigation to municipal and industrial use. The Weber Basin Project was constructed in the 1950's and 1960's to supplement two earlier Reclamation water projects, the Weber River and Provo River Projects. It supplies water for both irrigation and municipal and industrial use in Davis, Morgan, Summit, and Weber counties, Utah. A predictive model was developed and tested for prehistoric site locations in areas of project impact in Davis and Weber Counties. Class III intensive survey covered 1,500 acres in high sensitivity areas. Nine new sites were recorded and 14 previously recorded sites were visited. Of the 23 sites evaluated, 20 are considered significant. Additional Class III surveys are recommended, following a random sampling procedure, or done as developments occur. (Author's abstract)
W87-09335

STATE OF THE ENVIRONMENT, 1985.
Organization for Economic Co-Operation and Development, Paris (France).
Organization for Economic Cooperation and Development, Paris, France. 1985. 271 p.

Descriptors: *Environmental quality, *Resources management, *Evaluation, Public policy, Future planning, Management planning, Aquatic environment, Marine environment, Forests, Land resources, Wildlife, Industry, Agriculture, Environmental effects, Regulations, Legislation.

The second Organization for Economic Cooperation and Development (OECD) report on the state of the environment reviews progress achieved since the first OECD report in 1979 and the agenda of future policies, including major remaining issues and new emerging issues. It places them in the context of economic development in OECD countries, and of world ecological and economic interdependence. Also examined is the state of the environment itself concerning air, inland waters, the marine environment, land, forest and wildlife resources as well as solid waste and noise. The state of the environment is shaped by the pressures on the environment from human activities such as agriculture, energy, industry and transport activities, and the curative and preventive responses from the public, enterprises and government to these pressures. On the strength of the Report, assessment it is now possible to: (1) review the progress achieved since the first OECD report in 1979; (2) define the policy agenda, which includes unresolved past problems as well as new and emerging concerns; and (3) establish the economic and international context in which these problems and concerns should be considered and tackled. (Lantz-PTT)
W87-09336

EVALUATIONS OF THE RECREATIONAL POTENTIAL OF RESERVOIRS IN DESIGN PRACTICE,
For primary bibliographic entry see Field 2H.
W87-09360

EFFECTS OF INTERMITTENT EXPOSURE TO SUSPENDED SOLIDS AND TURBULENCE ON THREE SPECIES OF FRESHWATER MUSSELS,
Dept. of Biology, North Carolina Agricultural and Technical State Univ., Greensboro, NC 27411, USA.
D. W. Aldridge, B. S. Payne, and A. C. Miller.
Environmental Pollution, Vol. 45, No. 1, p 17-28, 1987. 3 tab, 30 ref.

Descriptors: *Water pollution effects, *Suspended solids, *Turbulence, *Mussels, Navigation, Dredg-

ing, Population exposure, Metabolism, Food habits, Diets.

A laboratory experiment was performed to evaluate the effects of intermittent suspended solids exposure on the unionid clams Quadrula pustulosa, Fusconaia cerina and Pleurobema beadleanum. Intermittent impacts of this type are important effects of commercial navigation traffic in freshwater. Clams were cyclically exposed to turbulence alone or accompanied by 600-750 mg/L of suspended inorganic solids for 9 days. Clams exposed to suspended solids every 3 h reduced their metabolic rate but did not shift from the mainly protein based catabolism of controls. Feeding impairment was apparently compensated for by a reduction in metabolic demand. Conversely, clams exposed every 0.5 h to suspended solids shifted to virtually complete reliance on non-protein body stores as indicated by O:N values averaging 197. (Author's abstract)
W87-09381

ARCHAEOLOGICAL AND HISTORICAL SURVEYS OF SELECTED PORTIONS OF THE UMATILLA BASIN PROJECT, UMATILLA COUNTY, OREGON,
Western Archaeological Consultants, Inc., Boulder, CO.
M. S. Burney, S. F. Mehls, and J. Grady.
Volume 1 of 2 volumes. Final Report, August 21, 1985. 120 p, 5 tab, 157 ref, 2 append.

Descriptors: *Surveys, *Project planning, *Pumping plants, *Archaeology, *Water resources development, Irrigation requirements, Water requirements, Dams, Pumped storage, Fisheries, Reservoirs, Future planning, Fish management, Planning.

This report will provide the Bureau of Reclamation with data on the location, extent, and possible significance of the cultural resources on a portion of lands to be directly affected by construction of the Columbia River Pumping Plant as part of the Umatilla Basin Project. This preferred plan is a fishery enhancement plan to restore salmon runs and enhance steelhead runs in the Umatilla River Basin. The plan will attempt to improve streamflows by importing water from the Columbia River and developing headwater storage to capture excess winter and spring runoff. The Columbia River pumping feature includes a program wherein water would be pumped from the Columbia into existing Cold Springs Reservoir for distribution to irrigators. The Umatilla Basin Project has been reformulated to group the major geographical areas into alternative plans. The Meacham Reservoir and riparian rehabilitation of Meacham Creek is now the alternative plan which would be considered for development, if after a suitable evaluation period (three to four generations of salmon), the Columbia River Pumping plant alternative does not meet the fisheries restoration goals. Class II archaeological surveys of the Meacham Dam and Reservoir area south of Gibbon and the Cold Springs National Wildlife Refuge, including portions of the alignment of the Columbia River pumping plant discharge pipeline and canal, north-northeast of Stanfield recorded five historic sites. None of these are being recommended eligible to the National Register of Historic Places. (Geiger-PTT)
W87-09425

GUIDELINES FOR SAMPLING AND ANALYZING SOLUTIONS FROM AQUIFER THERMAL-ENERGY-STORAGE SYSTEMS,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5A.
W87-09457

LIMNOLOGICAL INVESTIGATIONS: LAKE KOOCANUSA, MONTANA; PART 3: BASIC DATA, POST-IMPOUNDMENT, 1972-1978,
Corps of Engineers, Seattle, WA. Seattle District.
For primary bibliographic entry see Field 2H.
W87-09463

DETAILED PROJECT REPORT AND ENVIRONMENTAL ASSESSMENT: SECTION 111, SHORES EAST OF DIKED DISPOSAL AREA, LORAIN HARBOR, OHIO.
Corps of Engineers, Buffalo, NY. Buffalo District.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-120366, A16 in paper copy, A01 in microfiche. Final Report, November 1981. 320 p, 5 fig, 7 append + Environmental Assessment. Contract No. DACW 49-80-C-0035.

Descriptors: *Hydraulic structures, *Environmental effects, *Erosion, *Dikes, *Breakwaters, Lorain Harbor, Ohio, Dredging, Shore protection, Lake shores, Beach erosion, Lake Erie.

A study of the shoreline erosion at Lorain Harbor, Ohio, indicated that the diked disposal area, which was constructed in 1977 to contain dredged sediments, was responsible for some, but not all, of the erosion east of the structure. A revetment plan was suggested to mitigate the erosion problem. However, Federal responsibility for costs was limited to that portion of the erosion attributable to the Federally-constructed diked disposal area. Other structures in the harbor included the east and west breakwaters (1901-1915) and a connection between the east breakwater and the shore in 1963. (Cassar-PTT)
W87-09491

EXAMINATION OF TIDAL FLATS, VOL. 3: EVALUATION METHODOLOGY.
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 4C.
W87-09493

MANUAL OF STREAM CHANNELIZATION IMPACTS ON FISH AND WILDLIFE,
Environmental Science and Engineering, Inc., Gainesville, FL.
P. W. Simpson, J. R. Newman, M. A. Keirn, R. M. Matter, and P. A. Guthrie.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-124628, A08 in paper copy, A01 in microfiche. FWS/OBS-82/24, July 1982. Fish and Wildlife Service, Washington, DC. 154 p, 27 fig, 16 tab, 234 ref.

Descriptors: *Environmental effects, *Channeling, *Wildlife, *Aquatic habitats, *Stream improvement, Channel improvement, Fish, Aesthetics, Land use, Water quality, Stream erosion, Channel morphology, Habitats, Vegetation, Aquatic life, Aquatic animals, Aquatic plants, Dissolved oxygen, Oxygen demand, Temperature, Sediments, Nutrients, Fate of pollutants, Legislation, Legal aspects, Flood control, Soil conservation, Stream classification, Ecosystems, Flow characteristics, Benthos, Invertebrates, Drainage, Dredging, Birds, Reptiles, Stream banks.

Literature on the effects of stream channelization on fish and wildlife resources was organized into a manual including: (1) legislation authorizing channelization and legislation for protecting fish and wildlife during channelization activities, (2) structural, physical, and chemical impacts (stream morphology, flow, water quality), (3) biological impacts--historical, on aquatic systems, on terrestrial and riparian systems, above and below channelized segments, (4) recovery of channelized streams, and (5) impacts on human uses of fish and wildlife resources. Some of the many findings include the following conclusions. Physical changes in a stream can affect solids and sediments, light, temperature, dissolved oxygen and other gases, dissolved solids, oxygen demand, nutrients, and toxic substances. Direct biological effects include mortality, injury, and habitat destruction. Indirect biological effects concern habitat changes that create conditions less than ideal for the prechannelization organisms and result in shifts in population composition, dominance, diversity, etc. Vegetation is directly affected by clearing, dredging and spoil deposition; it is indirectly affected by drying and dewatering of the land. Channelization impacts also occur upstream and downstream of the changed segment; aquatic life upstream is particularly affected. Recovery of channelized streams depends on stream type, nature of channelization activities, time, mitigation or maintenance techniques, and surrounding land use. In most cases, esthetic values are reduced by channelization. (Cassar-PTT)
W87-09497

HYDROGEOLOGICAL ASPECTS OF COAL MINING UNDER STORED WATERS NEAR SYDNEY, AUSTRALIA,
Water Resources Commission, Sydney (Australia).
For primary bibliographic entry see Field 2F.
W87-09587

7. RESOURCES DATA

7A. Network Design

HARMONIZATION OF BIOLOGICAL TESTING METHODOLOGY: A PERFORMANCE-BASED APPROACH,
Environmental Monitoring Systems Lab., Las Vegas, NV.
For primary bibliographic entry see Field 5A.
W87-08646

GEOGRAPHIC INFORMATION SYSTEM TO PREDICT NON-POINT SOURCE POLLUTION POTENTIAL,
Nebraska Univ.-Lincoln. Dept. of Civil Engineering.
M. W. Gilliland, and W. Baxter-Potter.
Water Resources Bulletin WARBAQ, Vol. 23, No. 2, p 281-291, April 1987. 7 fig, 2 tab, 21 ref.

Descriptors: *Geographic information system, *Data interpretation, *Water pollution sources, Bacteria, Runoff, Water quality, Sediments, Topography.

Bacterial densities (total coliform, fecal coliform, and fecal streptococci) and suspended solids in runoff from a feedlot, pasture, and corn field were measured. Densities of fecal coliform were highest from the feedlot but were 1000 to 10,000 times greater than the water quality standard for swimmable waters from all three land uses. Densities of fecal streptococci were highest from the corn field, which suggests that wildlife are the source of bacteria. Fecal coliform/fecal streptococci ratios distinguished cattle from wildlife as the source of bacterial pollution both among land uses and among seasons of the year. Suspended solids concentrations in runoff ranged from 423 to 925 mg/l and were highest from the corn field. A Geographic Information System (GIS), which utilizes a raster or grin-cell format, was developed to include algorithms associated with non-point source pollution. The system accepts digitally mapped information on soil type, topography, and land use. It calculates characteristics such as slope and slope length, and relates these characteristics to soils and land use parameters in order to produce three dimensional maps of runoff potential, sediment pollution potential, and bacterial pollution potential. It offers the advantages of retaining the geographical character of pollution potential information and of conveying in three-dimensional graphical terms the effects of topography, soil type, land use, and land management practices. (Author's abstract)
W87-08977

FIELD VALIDATION,
Environmental Research Lab., Athens, GA.
W. M. Sanders.
IN: Fundamentals of Aquatic Toxicology: Methods and Applications. Hemisphere Publishing Corporation, Washington DC. 1985. p 601-618, 25 ref.

Descriptors: *Toxicity, *Field tests, *Water pollution effects, *Aquatic toxicology, *Evaluation, Data acquisition, Sampling, Cost analysis, Model testing.

Scientists and developers of new chemicals, materials, analytical methods, toxicity test procedures, protocols, and exposure and risk assessment models are anxious to evalute the performance of their

products against a variety of real world conditions to assure their scientific validity and acceptability in environmental decision making. Thus, demands increase for a variety of 'field validation' studies to be carried out in conjunction with aquatic toxicology programs. A distinction is made between a scientific evaluation of a method, test, or model with field data where the objective is to determine the degree of correspondence, goodness of fit, or confidence limits, and a field validation study where the results of using a method, test, or model to solve a particular problem are compared to data collected in the field (representing perceived reality) and judged to be balid or invalid on the basis of preselected criteria of acceptability. These criteria of acceptability should be set by decision officials and the strength of the criteria should correspond to the consequences of the decision. Field sampling and analysis programs are time and resource intensive. It is recommended that a systems approach be applied to planning and executing the entire field program and, if available, exposure or risk models should be utilized in a screening or sensitivity analysis mode in developing cost-effective sampling plans. Automated data analysis systems should be used in receiving, storing, analyzing, and comparing the collected data. Becuase of the high costs (manpower, facilities, equipment, and dollars) associated with field sampling programs, benefit-cost analyses should be conducted as part of the planning exercise and only those studies that show benefits in excess of costs should be undertaken. If adequate resources are not available, the field validation studies should not be attempted. (See also W87-09280) (Lantz-PTT)
W87-09300

ON-SITE OBSERVATIONS OF THE STATE OF STRUCTURES AT THE KANEV LOCK,
S. I. Karlin.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 7, p 436-444, July 1986. 3 fig, 1 tab, 6 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 41-47, July 1986.

Descriptors: *Data aquisition, *Monitoring, *Locks, *Navigation, *Structures, *Measuring instruments, *USSR.

The navigation structures of the Kanev hydroelectric station were equipped with monitoring and measuring instruments. Control observations of settlements and misalignments of sections of the concrete structures, individual mutual deformations of the sections along expansion and settlement joints, seepage regime, and also observations of the static work of standard sections of the lock chamber and rectilinear leading jetty of the downstream jetty approach were specified for monitoring. About ninety percent of these instruments are still operating, enabling the lock operating service to systematically check the state and behavior of the concrete and earth structures. This report summarizes the observations made using these measuring instruments. (Ram-PTT)
W87-09363

MAPPING THE DISTRIBUTION OF PROTECTED AND VALUABLE, OIL-SENSITIVE COASTAL FISH AND WILDLIFE,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
C. D. Getter, L. C. Thebeau, T. Ballou, and D. J. Maiero.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 325-329, 5 fig, 1 tab, 5 ref.

Descriptors: *Mapping, *Oil spills, *Distribution patterns, *Environmental effects, *Ecological effects, Environmental control, Environmental protection, Ecological distribution, Oil pollution, Oil, Coastal waters.

An approach has been developed to produce a map series that displays known, pertinent information concerning the distribution, seasonality, and habitats of protected and valuable coastal fish and wildlife that are sensitive to oil spill impacts. This involves a compilation of all literature on the protected and oil-sensitive fish and wildlife for a region. Distribution and abundance data are then evaluated for each species, and all point localities, aggregations, and home ranges are shown on maps. These data include marine mammal haul-out and pupping areas, terrestrial mammal feeding areas, marine bird rookeries, salmon and herring streams and intertidal spawning sites, marine turtle nesting beaches, and intertidal shellfish beds. Aerial surveys are then made of the sites located during the literature search to verify the mapped literature data, as well as to add new wildlife localities. Information on the species, their distribution and ecological type, their habits, and seasonality is color coded on the maps. This approach has been applied to coastal areas in Shelikof Strait (Alaska), Puget Sound (Washington), southeastern Florida, and Massachusetts, and is underway for South Carolina and Norton Sound (Alaska). (See also W87-09507) (Author's abstract)
W87-09540

7B. Data Acquisition

APPLICATION OF METEOROLOGICAL RADAR DATA FOR SIMULATION OF STREAMFLOW WITH A HYDROLOGICAL MATRIX MODEL (UTILISATION DES DONNEES D'UN RADAR METEOROLOGIQUE POUR LA SIMULATION DES ECOULEMENTS EN RIVIERE A L'AIDE D'UN MODELE HYDROLOGIQUE MATRICIEL),
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
J. P. Fortin, H. Proulx, and A. Bellon.
Journal of Hydrology JHYDA7, Vol. 90, No. 3/4, p 327-350, April 1987. 11 fig, 2 tab, 17 ref.

Descriptors: *Streamflow forecasting, *Remote sensing, *Radar, *Model studies, *Rainfall, Algorithms, Estimating, Calibrations, Comparison studies, Convection, Weather data collections.

A good knowledge of the spatial and temporal distribution of precipitation is required for streamflow forecasting with a mathematical model. Thus, an operational method for correcting and integrating radar and station data with a minimum of operator intervention is under development. A total of 297 CAPPI maps at a height of 2 km have been used, each map representing a 2h accumulation for 43 rainy days in the summer of 1978. Preliminary results have shown that it is necessary to detect and correct ground clutter as well as echoes coming from anomalous propagation. Thus, an algorithm has been developed to do so. In order to obtain a better idea on the necessity of correcting those echoes and on the efficiency of the algorithm, estimations of the mean areal daily rainfalls on the basin calculated from station data, are compared to estimations computed from (a) raw radar data, (b) radar data corrected with a ground clutter mask, and (c) radar data corrected with the developed algorithm, before and after calibration with station data. Similar comparisons between measured streamflows and streamflows computed by the CEQUEAU model, are presented, except for raw radar data. Actual results show that the identification and correction algorithm behaves very satisfactorily and could permit the operational use of radar data with hydrological models. Moreover, the sensitivity of the calibration factor on the number of meteorological stations is studied. It is shown that a relatively small number of stations may be used to calibrate the radar data. However, this number should be greater for convective than for continuous rain. (Author's abstract)
W87-08623

MEASURING FISH LENGTHS FROM INSTANT PHOTOGRAPHS USING A DIGITIZING TABLET AND MINICOMPUTER,
Lilly Research Labs., Greenfield, IN.
S. Sauter, and J. L. Harrison.
IN: Aquatic Toxicology and Hazard Assessment: Eighth Symposium, Fort Mitchell, Kentucky, April 15-17, 1984. ASTM Special Technical Publication 891, 1985. p 321-327, 1 fig, 1 tab, 19 ref.

Descriptors: *Fish, *Growth, *Photography, *Data acquisition, *Water pollution effects, Computers, Toxicity, Statistical methods.

Partial and full life-cycle toxicity studies with fish include an assessment of growth at prescribed intervals based on measurements of length or weight or both. The importance of proper equipment and techniques on making such determinations was recognized early in the development of these studies. Early techniques involved anesthetization and confinement of fish for direct measurement, and fish measurements were sometimes avoided to eliminate handling stress to the animals. A modification of photographic techniques for measurement of fish lengths has been developed, which uses instant photography and a digitizing tablet with a minicomputer. Instant photography allows print inspection while live fish are retained and 'retakes' of poor quality photographs can be made. A photographic record of test animals is obtained, and fish may then be measured from the photographs at any convenient time. The digitizing tablet decreases time for fish measurement from photographs and maintains or improves accuracy over manual techniques. Raw data are entered directly into the minicomputer, which is programmed to perform summary statistics after all groups are measured. Summary statistics and raw data are printed to a prescribed format by the computer. The elimination of manual data entry and subsequent data validation will result in a substantial savings in time. (See also W87-08624) (Author's abstract)
W87-08649

RELATIVE ACCURACY OF SATELLITE AND RAINGAGE RAINFALL MEASUREMENTS OVER MIDDLE LATITUDES DURING DAYLIGHT HOURS,
McGill Radar Weather Observatory, Ste. Ann de Bellevue (Quebec).
For primary bibliographic entry see Field 2B.
W87-08700

BARE SOIL EVAPORATION NEAR A SURFACE POINT-SOURCE EMITTER,
Arizona Univ., Tucson. Dept. of Soil and Water Science.
For primary bibliographic entry see Field 2D.
W87-08743

MONITORING WELL INSTALLATION, PURGING, AND SAMPLING TECHNIQUES - PART 1: CONCEPTUALIZATIONS,
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
J. F. Keely, and K. Boateng.
Ground Water GRWAAP, Vol. 25, No. 3, p 300-313, May-June 1987. 8 fig, 3 tab, 19 ref.

Descriptors: *Sampling, *Test holes, *Test wells, *Monitoring, *Groundwater pollution, *Monitoring wells, *Well drilling, *Purging, Wells, Boreholes, Casings, Field tests.

Commonly employed techniques for the installation, purging, and sampling of monitoring wells are examined. The degree to which hollow-stem augering disturbs the near-borehole environment, and how this may result in the movement of contaminated solids or fluids from one stratum to another is discussed. The desirability of driving temporary casing to shield one stratum from another, and to improve the general quality of the monitoring well installation (especially the effectiveness of the filter pack emplaced), is argued. A call for further testing of sampling devices, based on limited field comparisons and a lack of reports of conclusive tests elsewhere, is given. (Author's abstract)
W87-08755

METHOD FOR MEASURING SELECTIVE LIGHT ATTENUATION WITHIN A PERIPHYTIC COMMUNITY,
Amsterdam Univ. (Netherlands). Vakgroep Aquatische Oecologie.
J. T. Meulemans.
Archiv fuer Hydrobiologie AHYBA4, Vol. 109, No. 1, p 139-145, March 1987. 5 fig, 11 ref.

Descriptors: *Analytical methods, *Light penetration, *Periphyton, Field tests, Limnology, Light quality, Shade.

A method of measuring light within a periphytic layer is presented. Light profiles were made in periphyton of different developmental stages. Light was strongly and selectively reduced in the uppermost few millimeters of the periphyton. It was demonstrated in the field that water movements can enhance the irradiance inside periphyton. When periphyton reached its maximal development, self-shading was responsible for more than 90 percent of the light attenuation in its underlayer. (Author's abstract)
W87-08769

TEMPORAL OBSERVATIONS OF SURFACE SOIL MOISTURE USING A PASSIVE MICROWAVE SENSOR,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2G.
W87-08781

MEASUREMENT OF SOIL WATER CONTENT USING THE COMBINED TIME-DOMAIN REFLECTOMETRY - THERMAL CONDUCTIVITY PROBE,
National Research Council of Canada, Ottawa (Ontario). Inst. for Research in Construction.
For primary bibliographic entry see Field 2G.
W87-08796

DETERMINATION OF TRACE METALS IN A RIVER WATER REFERENCE MATERIAL BY INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY,
National Research Council of Canada, Ottawa (Ontario). Div. of Chemistry.
For primary bibliographic entry see Field 5A.
W87-08832

LEAF THICKNESS AND WATER DEFICIT IN PLANTS: A TOOL FOR FIELD STUDIES,
Dept. of Applied Biology, Cambridge (England).
For primary bibliographic entry see Field 2D.
W87-08847

DYNAMICS OF BOTTOM CURRENTS IN A SMALL LAKE,
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'hydraulique.
For primary bibliographic entry see Field 2H.
W87-08865

'SPRAY-COLUMN' LABORATORY APPARATUS FOR ORGANIC MATTER EXTRACTION FROM SLUDGES,
Stazione Sperimentale per l'Industria delle Pelli e delle Materie Concianti, Naples (Italy).
For primary bibliographic entry see Field 5A.
W87-08913

PHOTOSYNTHESIS AND LIGHT ADAPTATION IN EPIPHYTE-MACROPHYTE ASSOCIATIONS MEASURED BY OXYGEN MICROELECTRODES,
Copenhagen Univ. (Denmark). Freshwater Biological Lab.
K. Sand-Jensen, and N. P. Revsbech.
Limnology and Oceanography LIOCAH, Vol. 32, No. 2, p 452-457, March 1987. 4 fig, 14 ref. Carlsberg Foundation Grant 1983/84 124/IV.

Descriptors: *Measuring instruments, *Analytical methods, *Microelectrodes, *Limnology, *Oxygen, *Photosynthesis, *Epiphytes, *Macrophytes, Lakes, Leaves, Light intensity, Attenuation.

Profiles of oxygen and photosynthesis were measured by a microelectrode within 1-2-mm-thick epiphyte layers on leaves of Potamogeton crispus. Photosynthetic rates showed one maximum near the surface of the epiphytic community and a second maximum at the leaf surface. Oxygen release from the association to the overlying water was positive down to low irradiances (22-37 microEinst/sq m/s), and despite extensive self-shading, maximum oxygen release occurred at only 300 microEinst/sq m/s. Light attenuation by the epiphytes reduced leaf photosynthesis at low light, but neither light attenuation nor impedance of gas exchange altered photosynthetic rate at the high intensities characteristic of midday. (Author's abstract)
W87-08935

TROPICAL SQUALL LINE OBSERVED DURING THE COPT 81 EXPERIMENT IN WEST AFRICA. PART I: KINEMATIC STRUCTURE INFERRED FROM DUAL-DOPPLER RADAR DATA,
Centre de Recherche en Physique de l'Environnement Terrestre et Planetaire, Issy-les-Moulineaux (France).
For primary bibliographic entry see Field 2B.
W87-08939

TWO NEW GROUND-LEVEL CLOUD WATER SAMPLER DESIGNS WHICH REDUCE RAIN CONTAMINATION,
Appalachian Mountain Club, Gorham, NH. Research Dept.
B. Daube, K. D. Kimball, P. A. Lamar, and K. C. Weathers.
Atmospheric Environment ATENBP, Vol. 21, No. 4, p 893-900, April 1987. 5 fig, 3 tab, 24 ref.

Descriptors: *Acid rain, *Monitoring, *Cloud water collectors, *Sampling devices, *Rainfall analysis, *Cloud water, Rainfall, Precipitation, Design, Winds, Performance evaluation.

The ability to obtain discrete samples of cloud water for chemical analysis during periods when precipitation is occurring is important for studies of potential ecological effects of cloud and rain deposition. The advantage of the two cloud water collector designs presented, over others reported in the literature, is their ability to greatly reduce the entry of horizontally blown drizzle and rain droplets (> 200 micron) into the collector. The CWP Active Cloud Water Collector can be used in either stagnant or windy environments and requires 12 V battery power. The AMC/WPI Passive Cloud Water Collector is designed for windy environs and requires no power. Both collectors use removable cartridges with Teflon strands as a collection surface, and collect cloud droplets by inertial impaction. On Mount Washington, NH, the Active and Passive Cloud Water Collectors had an average cloud water collection rate of 1.8 and 1.5 ml/min, respectively. (Author's abstract)
W87-08948

THEORY AND PRACTICE IN THE ELECTROMETRIC DETERMINATION OF PH IN PRECIPITATION,
Illinois State Water Survey Div., Champaign. Analytical Chemistry Lab Unit.
C. J. Brennan, and M. E. Peden.
Atmospheric Environment ATENBP, Vol. 21, No. 4, p 901-907, April 1987. 5 fig, 7 ref. EPA Contract EPACR810780-01.

Descriptors: *Acid rain, *Electrometric determination, *Hydrogen ion concentration, *Rainfall analysis, *Measuring instruments, Precipitation, Rainfall, Ions, Electrodes, Design criteria, Performance evaluation.

Basic theory and laboratory investigations have been applied to the electrometric determination of pH in precipitation samples in an effort to improve the reliability of the results obtained from these low ionic strength samples. The theoretical problems inherent in the measurement of pH in rain have been examined using natural precipitation samples with varying ionic strengths and pH values. The importance of electrode design and construction has been stressed. The proper choice of electrode can minimize or eliminate problems arising from residual liquid junction potentials, streaming potentials and temperature differences. Reliable pH measurements can be made in precipitation samples using commercially available calibration buffers providing low ionic strength quality control solutions are routinely used to verify electrode and meter performance. (Author's abstract)
W87-08949

CHROMATOGRAPHIC STUDIES OF DISSOLVED ORGANIC MATTER AND COPPER-ORGANIC COMPLEXES ISOLATED FROM ESTUARINE WATERS,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
G. L. Mills, E. McFadden, and J. G. Quinn.
Marine Chemistry MRCHBD, Vol. 20, No. 4, p 313-325, March 1987. 3 fig, 2 tab, 33 ref. NSF Grant OCE-8200150; DOE Contract DE-AC09-76SR00-819.

Descriptors: *Analytical methods, *Measuring instruments, *Dissolved organic matter, *Copper-organic complexes, *Estuaries, *Reversed phase chromatography, Extraction, Columns, Elution, Copper.

Dissolved organic matter (DOM) and dissolved copper-organic complexes were isolated from the estuarine waters of Narragansett Bay, RI, using reverse-phase liquid chromatography (RPLC). Different types of reverse-phase BOND ELUT columns (Analytichem International), including C2, C18 and phenyl-bonded phases, were studied to determine their adsorption efficiency for extracting DOM. Extraction efficiencies followed the order phenyl > C18 > C2, and phenyl = C18 > C2 for DOM and organic copper, respectively. However, comparisons of BOND ELUT and C18 SEP-PAK (Waters Associates) columns indicated that SEP-PAK columns were the most efficient when both DOM and organic copper were considered. Chromatographic profiles of the isolated DOM obtained using high-performance liquid chromatography were similar in elution characteristics and resembled chromatograms typical of fulvic acid. The UV-absorption characteristics of the DOM showed small differences and suggested that the different reverse-phase columns isolated material that was qualitatively similar. Copper-organic complexes isolated using C18RPLC were studied to examine the dissociation of organically bound copper in seawater as the pH is lowered. Only a small amount of the complexed copper was displaced by the H(+) with about 40% of the copper remaining bound at pH 3. However, the chromatographic elution behavior of the DOM and organic copper was significantly altered under acidic conditions as a result of protonation of acidic functional sites on the organic matter. (Author's abstract)
W87-08960

LOW DISCHARGE PERIODS OF RIVERS IN THE UPPER VISTULA RIVER BASIN, POLAND,
A. Tlalka, and J. Tlalka.
Water Resources Bulletin WARBAQ, Vol. 23, No. 2, p 227-232, April 1987. 6 fig, 1 tab, 8 ref.

Descriptors: *Streamflow, *Low flow, *Data collections, *Discharge measurement, *Vistula River basin, *Flow discharge, Groundwater, Poland, Seasonal variation, Rivers, Flow.

A method is presented for determining low discharge periods of rivers based on threshold values defined in terms of mean of minimum summer (winter) discharges. The method is used to determine summer low flow periods in the Vistula River basin in Poland. Analysis is based on daily discharge data for 84 basins of the Upper Vistula River which was collected by the Polish institute of Meteorology and Water Economy. (Author's abstract)
W87-08970

DIGITAL CONTROLLER FOR DISCRETE STAGE ACTIVATION OF AUTOMATIC PUMPING SAMPLERS,
Oklahoma Dept. of Agriculture, Broken Bow. Forestry Div.
J. L. Vowell, and C. G. Hutchens.
Water Resources Bulletin WARBAQ, Vol. 23, No. 2, p 337-339, April 1987. 2 fig, 4 ref.

Descriptors: *Automation, *Measuring instruments, *Sampling devices, *Samplers, *Electrode controller, *Streams, Oklahoma, Field tests, Water quality, Performance evaluation.

An electrode controller was developed to facilitate water sampling at discrete stage heights in perennial mountain streams of southeast Oklahoma. The controller operates in conjunction with an automatic pumping sampler and a magnetic, relay transducer. In response to changes in stage, the transducer generates an electrical pulse when relays are closed by a magnetic float. The controller monitors these relay closures and signals the sampler to pump a single sample at each desired water level during both rising and falling stages. After a sample is taken, additional switch closures at that stage are ignored until the relay immediately above or below is closed. Inadvertent switch closures caused by turbulent stage fluctuations are not translated to the sampler thus eliminating duplicate or multiple samples at a given stage. Field testing has proven this device to be a reliable component with a range of applications for improving water quality sampling systems. The controller features battery operation, low power consumption, circuit simplicity and can be easily constructed for less than $100, including parts and labor. (Author's abstract)
W87-08983

VACUUM TROUGH EXTRACTORS FOR MEASURING DRAINAGE AND NITRATE FLUX THROUGH SANDY SOILS,
North Dakota Agricultural Experiment Station, Fargo.
B. R. Montgomery, L. Prunty, and J. W. Bauder.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 271-276, March-April 1987. 2 fig, 3 tab, 32 ref.

Descriptors: *Vacuum trough collectors, *Measuring instruments, *Leaching, *Path of pollutants, *Nitrates, *Drainage, *Sand, Lysimeters, Performance evaluation, Extractors, Irrigation, Corn.

Vacuum trough extractors have been used in a number of studies for quantifying NO3(-) leaching, despite limited data verifying their performance. In two studies, extractors were evaluated for measuring drainage. NO3(-)N concentrations, and NO3(-)-N flux under irrigated corn (Zea mays L.). In the first, extractors were placed within four large (2.4 by 2.4 by 2.3 m deep) drainage lysimeters. Extractors were placed at either 1.4 or 1.8 m below the surface of a reconstructed Hecia loamy fine sand. Quality and quantity of monthly outflow from extractors and lysimeter tile drains were directly compared over a 5-yr period. Drainage and NO3(-)-N flux from the extractors were significantly correlated to tile drain measurements during the entire study ($r = 0.09^{***}$ and 0.69^{***}, respectively). Overall, extractors underestimated drainage and NO3(-)-N flux (6 and 13%, respectively). Excluding the first year's data, extractors underestimated tile drainage by 3% and NO3(-)-N flux by 1%. Nitrate concentrations from tile drains appeared to lag 2 and 10 months behind the 1.8 and 1.4 m deep extractors, respectively. Nitrate-N concentrations (flow-weighted for duration of study) were 27 mg/L from tile drains and 25 mg/L from extractors. Vacuum levels at which the extractors were operated had very minor effects on quality and quantity of effluent collected. Extractors buried in narrow trenches 1.5 m below field plots were evaluated over a 5-yr period in the second study. These extractors were placed under a Maddock sandy loam receiving annual N rates of 0, 112, 224, and 224-split (3-way) kg/ha. Drainage measured by these extractors was 70% less than predicted by a water balance, which used the Jensen-Haise equation to calculate evapotranspiration. Although the extractors were found incapable of supplying drainage flux, NO3(-)-N concentrations were statistically the same as determined by nearby suction cups at the same depth. (Author's abstract)
W87-08989

PULSED NUCLEAR MAGNETIC RESONANCE INSTRUMENT FOR SOIL-WATER CONTENT MEASUREMENT: SENSOR CONFIGURATIONS,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
R. F. Paetzold, A. De Los Santos, and G. A. Matzkanin.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 287-290, March-April 1987. 1 fig, 1 tab, 8 ref.

Descriptors: *Soil moisture meters, *Measuring instruments, *Pulsed nuclear magnetic resonance, *Soil water, *Sensors, *Design standards, Magnets, Spectral analysis, Sensitivity, Performance evaluation.

Two sensor configurations of a prototype soil-water content measuring instrument were examined. The prototype instrument, based on pulsed nuclear magnetic resonance technology, is designed for field use and is capable of determining volumetric soil-water content at depths of 38, 51, and 63 mm. The magnet component of the sensor is modified by the use of pole pieces so that the sensor is capable of operating in two configurations, flat and extended. In the flat configuration, the sensor rides or floats directly on the soil surface, whereas in the extended configuration, two furrows about 10-cm deep are created in the soil to accommodate the extended configuration as opposed to the flat configuration. Furthermore, sensitivity decreases with increasing measurement depth. Sensitivity differences are explained in terms of magnetic field and radio-frequency signal characteristics. (Author's abstract)
W87-08991

FIELD METHOD FOR ESTIMATING HYDRAULIC CONDUCTIVITY AND MATRIC POTENTIAL-WATER CONTENT RELATIONS,
Utah Agricultural Experiment Station, Logan.
For primary bibliographic entry see Field 2G.
W87-08993

METHOD TO ESTIMATE SOIL LOSS FROM EROSION,
Illinois Univ. at Urbana-Champaign. Agricultural Experiment Station.
K. R. Olson, and A. H. Beavers.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 441-445, March-April 1987. 3 fig, 5 tab, 7 ref.

Descriptors: *Measuring instruments, *Soil erosion, *X-ray spectrographs, Weathering, Soil horizons, Clay, Soil properties, Spectral analysis, Estimating.

A new x-ray spectrograph procedure was developed for quantifying the extent of soil loss from erosion. Methods which rely on topsoil thickness or depth to the top of either the clay maximum or argillic horizon underestimate soil loss from accelerated erosion. Each soil examined has a characteristic mass absorption coefficient (mu sub M) line when plotted as a function of soil depth. As a soil erodes, the mass absorption coefficient line is altered. The maximum value of mu sub M reflects the accumulation of elements high in atomic mass including weathering products such as Fe and bases. The lower boundary of the subhorizon of maximum mu sub M coincides with the lower boundary of the argillic horizon for all pedons examined. The maximum value of mu sub M is one or two subhorizons below the zones of maximum clay and cation exchange capacity (CEC). The depth to maximum clay underestimates the amount of erosion when part of the clay maximum has been mixed into the topsoil by tillage. The change in depth to the lower boundary of the argillic horizon and/or subhorizon of maximum mu sub M are the best indicators of the amount of soil removed from an eroded pedon when compared with a slightly eroded (reference) pedon. These parameters are less likely than the clay maximum to be removed by accelerated erosion because of their greater depth in the profile. This procedure was tested using soils with argillic horizons and should be useful for soil erosion studies in areas having Alfisols, Ultisols, and Mollisols with argillic horizons. (Author's abstract)
W87-09007

SEMIPORTABLE MULTISLOT DIVISOR FOR EROSION AND RUNOFF MEASUREMENTS,
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
G. R. Bathke.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 485-487, March-April 1987. 3 fig, 1 tab, 15 ref.

Descriptors: *Measuring instruments, *Multislot divisors, *Soil erosion, *Runoff, Sediments, Field tests, Performance evaluation, Rainfall, Flow rates.

When comparing the effects of cropping systems on runoff and erosion characteristics, it is important to collect samples representative of the treatment area while minimizing variance due to other factors. To meet these requirements a multislot divisor for runoff and sediment collection from small plots was constructed and its feasibility for use in field experiments assessed. The collection system was designed to handle a 20.3-cm, 24-h rainfall event resulting in a soil loss of 33.5 Mg/ha. The divisor ratio was found to be 0.1111 + or - .0003 for flow rates ranging from 0.2 to 4.9 L/s. The sediment concentration ratio for nonsampled to sampled runoff was 0.9969 + or - .05, and was close to unity for each particle size separate. The compact size of this equipment facilitates easy installation and removal of the device with minimum disturbance to the site. (Author's abstract)
W87-09010

GAS CHROMATOGRAPHIC ANALYSIS OF VOLATILE COMPOUNDS IN WATER AND BIOLOGICAL SAMPLES WITH AN AUTOMATIC INJECTOR,
C. H. U., Angers (France). Lab. de Pharmacologie.
A. Cailleux, A. Turcant, P. Allain, D. Toussaint, and J. Gaste.
Journal of Chromatography JOCRAM, Vol. 391, No. 1, p 280-289, March 1987. 9 fig, 1 tab, 26 ref.

Descriptors: *Gas chromatography, *Automatic injectors, *Volatile organic compounds, *Analytical methods, *Measuring instruments, Isolation, Extraction, Headspace analysis, Cryogenics, Purging, Adsorption.

Methods for the isolation of volatile compounds from water and biological fluids, reviewed in many recent papers, can be divided into two categories: those utilizing headspace analysis and those utilizing extraction. The headspace methods involve sampling three gas phase in equilibrium with the liquid matrix in a sealed vessel. Extraction methods include solvent extraction, which is generally tedious and introduces problems due to impurities, and purge and trap techniques followed by adsorption and thermal desorption of volatile compounds before gas chromatographic (GC) analysis. In this paper, we describe a system which operates automatically on a series of twelve samples using either headspace or purge and trap methods with a cryogenic trap and a multidetector GC system. Traces of organic volatile compounds in liquids are extracted by an inert gas either by bubbling it through the liquid (purge and trap) or by passing a stream of it above the sample (dynamic headspace) and are swept from the gas phase of the purging vessel to a small trap containing an adsorbent. The trap is cooled with liquid nitrogen during the extraction step. For injection, the trap is rapidly heated and simultaneously purged with the carrier gas. (Alexander-PTT)
W87-09012

EVALUATION OF NATURAL TRACERS IN AN ACIDIC AND METAL-RICH STREAM,
Geological Survey, Menlo Park, CA.
K. E. Bencala, D. M. McKnight, and G. W. Zellweger.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 827-836, May 1987. 7 fig, 6 tab, 19 ref.

Descriptors: *Natural waters, *Tracers, *Acid streams, *Metals, Solutes, Streams, Ions, Comparison studies.

In natural waters, a variety of solutes would be appropriate for use as tracers in different situations. Comparisons were made of natural tracers at the confluence of an acidic stream (Snake River) with a pristine stream (Deer Creek) near Montezuma, Colorado. Three comparisons were made during late summer at low-flow conditions to identify the naturally occurring conservative solutes in the stream system: (1) a steady injection of chloride and sodium was used as an artificial, conservative baseline tracer to compare the behavior of silica, sulfate, and fluoride, (2) within the mixing zone of the confluence, comparisons were made of the lateral concentration gradients of sodium, calcium, magnesium, silica, sulfate, and fluoride, and (3) the conservative behavior of naturally occurring calcium, magnesium, silica, sulfate, fluoride, and manganese was evaluated from stream samples collected on four different days. On the basis of the results of these comparisons, manganese and sulfate were used as conservative solutes to demonstrate computation of: (1) the reactive losses of other solutes within the confluence and (2) the ratio of chemical inflows from Deer Creek and the Snake River. The approach used in this evaluation can be applied in the study of chemically similar acidic systems. (Author's abstract)
W87-09021

REMOTE SENSING: PRINCIPLES AND INTERPRETATION,
Chevron Oil Field Research Co., La Habra, CA.
F. F. Sabins.
Second Edition. W. H. Freeman and Co., New York, NY. 1987. 449 p.

Descriptors: *Data acquisition, *Remote sensing, *Data interpretation, *Satellite technology, Aerial photography, Infrared imagery, Telemetry.

Remote sensing is surveyed in the second edition of a book originally published in 1977. Since 1977 many new airborne and spaceborne systems have been deployed: Return Beam Vidicon System (Landsat 3), Thematic Mapper (Landsat 4 and 5), Shuttle Imaging Radar (Space Shuttle), Large Format Camera (Space Shuttle), Seasat Radar, Heat Capacity Mapping Mission, Advanced Very High Resolution Radiometer, Coastal Zone Color Scanner, Airborne Imaging Spectrometer, Thermal Infrared Multispectral Scanner. These new system provide images with improved spectral and spatial resolution over the 1977-vintage systems. The deployment of thermal IR, radar, and high-resolution cameras on satellites has increased coverage to encompass the entire world. The use of digital image processing systems is becoming commonplace, and many new programs are available. A major goal of this book is to communicate these developments. Another goal is to gain insight into nongeologic aspects. The first chapter summarizes the fundamental characteristics of electromagnetic radiation and the interactions of radiation with matter that are the basis of remote sensing. The vital concepts of spatial resolution and detection are explained using the eye as an example of a remote sensing system. Each of the next five chapters describes one of the following remote sensing systems: aerial photographs, manned satellite images, Landsat, thermal infrared images, and radar images. For each system, the following topics are covered: (1) Physical properties and electromagnetic interactions of the materials that control the imaging process; (2) Design and operation of the imaging system; (3) Characteristics of the images, including defects and geometric distortion that may distract or confuse the interpreter; and (4) Guidelines and examples for interpreting images. A chapter on digital image processing describes computer techniques for restoring and enhancing images and for extracting information. This rapidly expanding technology should be included in any remote sensing curriculum. The remaining chapters describe practical applications of remote sensing to the following fields: resource exploration, environmental applications, land use and cover analysis, and natural hazards. Chapter 12 compares a variety of images covering two test sites and demonstrates the advantages and disadvantages of various types of image for different applications. (Lantz-PTT)
W87-09065

HUMIC SUBSTANCES IN SOIL, SEDIMENT, AND WATER: GEOCHEMISTRY, ISOLATION, AND CHARACTERIZATION.
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2H.
W87-09067

EXTRACTION OF HUMIC SUBSTANCES FROM SOIL,
Birmingham Univ. (England). Dept. of Chemistry.
M. H. B. Hayes.
IN: Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization. John Wiley and Sons, New York, NY. 1985. p 329-362, 9 tab.

Descriptors: *Humic substances, *Soil chemistry, *Chemical reactions, *Water analysis, *Chemical analysis, Physicochemical properties, Soil water, Metals, Solvents, Humic acid, Hydrogen ion concentration.

Consideration of the dissolution of humic substances in a variety of solvents takes account of structures and some physicochemical properties of solutes and solvents. Special emphasis is given to the polyelectrolyte properties of humic substances, and to the secondary forces that must be overcome in the solvent and macromolecular systems before solution takes place. The classical extraction procedures use aqueous alkaline solvents and these give rise to partially oxidized and slightly degraded humic artifacts. The use of complexing agents, especially certain neutral salt solutions, frees insolubilizing divalent and polyvalent metals and allows the more polar humic components to dissolve in water. However, most humic acids are not dissolved in this way. There is a need for a mild, neutral, or even acidic solvent system that can match the dissolution performance of aqueous sodium hydroxide without giving rise to degradation or artifacts. Application of solubility parameter data is hindered by the multicomponent nature of humic substances, and homogeneous fractions are needed to obtain the necessary data for the macromolecules. Nevertheless, the available information shows that the best solvents for H(+) humic acids have polar, hydrogen bonding, and proton acceptor solubility parameters greater than 5. However, for solution to take place self-association of the solvent molecules through hydrogen bonding must be less than that for the solute-solvent systems. Some dipolar aprotic solvents satisfy the necessary criteria, and the best results have been obtained for slightly acidified dimethylsulfoxide. (See also W87-09067) (Author's abstract)
W87-09079

ISOLATION AND CONCENTRATION TECHNIQUES FOR AQUATIC HUMIC SUBSTANCES,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2H.
W87-09080

FRACTIONATION TECHNIQUES FOR AQUATIC HUMIC SUBSTANCES,
Geological Survey, Denver, CO. Water Resources Div.
J. A. Leenheer.
IN: Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization. John Wiley and Sons, New York, NY. 1985. p 409-429, 5 fig, 1 tab.

Descriptors: *Fractionation, *Aquatic environment, *Humic substances, *Water analysis, Chemical analysis, Chemical reactions, Chromatography, Organic compounds.

A review of current chemical and physical fractionation techniques for aquatic humic substances is presented in this chapter. Factors that hinder the fractionation of aquatic humic substances into individual compounds by conventional approaches include their polyfunctional character, which causes conformational and particle-size changes due to intra- and intermolecular weak-bonding mechanisms, multiple interactions with fractionating media, and high molecular weights that prevent fractionation by gas chromatography. Theoretically, it should be possible to fractionate aquatic humic substances into individual compounds by liquid chromatography. The most promising chromatographic approaches include normal-phase liquid chromatography on weak-base substrates, or reverse-phase liquid chromatography where humic solutes are disaggregated by heating the mobile phase, use of highly polar mobile phases, or by use of polar supercritical-fluid mobile phases. Prior chemical derivatization of polar interacting functional groups to less polar groups should aid in the liquid-chromatographic separations. Methods for forming the methyl and trifluoroethyl esters of carboxyl groups, the acetyl ester and trifluoroethyl ether of hydroxyl groups, and the reduced alcohol of the carbonyl group are presented. Lastly, analytical and preparative fractionation procedures were formulated with the goal of obtaining pure compounds from aquatic humic substances for structural studies. (See also W87-09067) (Author's abstract)
W87-09082

ANALYTICAL METHODOLOGY FOR ELEMENTAL ANALYSIS OF HUMIC SUBSTANCES,
Huffman Laboratories, Inc., Wheat Ridge, CO.
E. W. D. Huffman, and H. A. Stuber.
IN: Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization. John Wiley and Sons, New York, NY. 1985. p 433-455, 1 fig, 6 tab.

Descriptors: *Chemical analysis, *Water analysis, *Chemical analysis, *Humic substances, Carbon, Nitrogen, Hydrogen, Oxygen, Sulfur, Ash, Chlorine, Phosphorus, Temperature.

The applicability of the usual methods of elemental analysis was studied by comparing results obtained by four different laboratories on three different humic and fulvic acid preparations. Identical freeze-dried specimens of each sample were analyzed for carbon, hydrogen, oxygen, nitrogen, sulfur, ash, chlorine, phosphorus, and water content. The results obtained for carbon and hydrogen were within the usually accepted precision ranges of + or - 0.3% for organic elemental analysis but only when corrected using an accurately determined water content. There were large variations between laboratories in the water content determined as weight loss at 60 C under vacuum, which resulted in unacceptable differences in results between laboratories, especially for hydrogen. Water determined by the Karl Fischer method showed greater precision and it is recommended that water in humic substances be determined by this method. A study of the weight loss under vacuum of the three samples at room temperature, 40, 60, 80 and 100 C and the consequent weight regain on exposure to air was conducted. Rapid regain of moisture indicates these materials should be analyzed on an equilibrated basis rather than dried and that water be determined separately. Results obtained for oxygen, nitrogen, ash, chlorine, and phosphorus showed greater variations than commonly accepted, indicating that caution should be used in interpreting the percentage of these components determined in humic substances. (See also W87-09067) (Author's abstract)
W87-09083

IMPLICATIONS OF ELEMENTAL CHARACTERISTICS OF HUMIC SUBSTANCES,
Arizona Univ., Tucson. Dept. of Chemistry.
C. Steelink.
IN: Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization. John Wiley and Sons, New York, NY. 1985. p 457-476, 4 fig, 7 tab.

Descriptors: *Humic substances, *Chemical analysis, *Pollutant identification, *Water analysis, Fate of pollutants, Path of pollutants, Soil, Marine environment, Aquatic environment, Humic acid, Fulvic acid, Lake sediments.

Elemental composition is an important chemical property which can be used to establish the nature

and source of humic substances. When the percent composition data are displayed as the atom ratios H/C, O/C, and N/C, some general characteristics become visible. Soil, coal, marine, and aquatic humates may be distinguished, one from the other. Structural trends may be identified in specific environments, such as lake sediments and soil profiles. Nonhumate contaminants can be detected. Atom ratios may also aid the investigator in proposing hypothetical structures for humic and fulvic acids and serve as a guide in the synthesis of artificial humates. Although the elemental composition is a useful guide, its validity is dependent on the purity of the sample and the operational definition of a humic substance. This requires a consensus among investigators on the methodology for extracting humates from their environments and also a consensus on what fraction of this extracted material will be labeled 'humic' or 'fulvic.' Fortunately, significant progress has been made toward this consensus during the past 5 years. In the near future, it will be possible to obtain reproducible analytical data on a rigorously defined humic fraction. (See also W87-09067) (Author's abstract)
W87-09084

MOLECULAR SIZE AND WEIGHT MEASUREMENTS OF HUMIC SUBSTANCES,
Geological Survey, Denver, CO.
R. L. Wershaw, and G. R. Aiken.
IN: Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization. John Wiley and Sons, New York, NY. 1985. p 477-492, 1 tab.

Descriptors: *Chemical analysis, *Molecular structure, *Humic acids, *Humic substances, Chromatography, Ultrafiltraiton, Electromagnetic waves, Ultracentrifugation.

A brief overview of the most commonly used methods for determining molecular weight and size of humic substances is presented. Methods discussed for measuring molecular size are: gel permeation chromatography, ultrafiltration, scattering of electromagnetic radiation, and electron microscopy. Methods discussed for measuring molecular weight are: ultracentrifugation, viscometry, and colligative-property measurements. Emphasis is placed on the limitations and problems of each method. The chemical properties of humic substances that interfere with molecular weight determination by these methods and result in questionable data are discussed. (See also W87-09067) (Author's abstract)
W87-09085

SPECTROSCOPIC METHODS (OTHER THAN NMR) FOR DETERMINING FUNCTIONALITY IN HUMIC SUBSTANCES,
Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.
P. MacCarthy, and J. A. Rice.
IN: Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization. John Wiley and Sons, New York, NY. 1985. p 527-559, 17 fig.

Descriptors: *Chemical analysis, *Humic substances, *Humic acids, *Spectroscopy, Molecular structure, Infrared spectroscopy, Raman spectroscopy, Ultraviolet-visible spectroscopy, Spectrofluorimetry, Electron spin resonance spectroscopy, Meausuring instruments.

The applicability of spectroscopic methods (other than NMR) for determining functionality in humic substances is reviewed. Spectroscopic methods, like all other investigational techniques, are severely limited when applied to humic substances. This is because humic substances are comprised of complicated, ill-defined mixtures of polyelectrolytic molecules, and their spectra represent the summation of the responses of many different species. In some cases only a small fraction of the total number of moleculares contributes to the measured spectrum, further complicating the interpretation of spectra. The applicability and limitations of infrared spectroscopy, Raman spectroscopy, UV-visible spectroscopy, spectrofluorimetry, and electron spin resonance spectroscopy to the study of humic substances are considered in this chapter. Infrared spectroscopy, while still very limited when applied to humic substances, is by far the most useful of the methods listed above for determining functionality in these materials. Very little information on the functionality of humic substances has been obtained by any of the other spectroscopic methods. (See also W87-09067) (Author's abstract)
W87-09087

APPLICATION OF NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY FOR DETERMINING FUNCTIONALITY IN HUMIC SUBSTANCES,
Geological Survey, Denver, CO.
R. L. Wershaw.
IN: Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization. John Wiley and Sons, New York, NY. 1985. p 561-582, 1 fig, 3 tab.

Descriptors: *Chemical analysis, *Nuclear magnetic resonance spectroscopy, *Humic substances, *Humic acids, Spectroscopy, Molecular structure.

A wide variety of chemical and spectroscopic techniques has been used to determine functionality in humic substances. Although nuclear magnetic resonance (NMR) spectroscopy has been used for a much shorter periopd of time than most other techniques for determining functional group concentrations, this technique has provided far more definitive information than all other methods combined. However, substantially more work must be done to obtain the quantitative data that are necessary for both structural elucidation and geochemical studies. In order to increase the acuracy of functional group concentration measurements, the effect of variations in nuclear Overhauser enhancement (NOE) and relaxation times must be evaluated. Preliminary results suggest that spectra of fractions isolated from humic substances should be better resolved and more readily interpreted than spectra of unfractionated samples. (See also W87-09067) (Author's abstract)
W87-09088

URBAN STORMWATER HYDROLOGY.
American Geophysical Union, Washington, DC.
For primary bibliographic entry see Field 4C.
W87-09096

DATA COLLECTION AND INSTRUMENTATION,
Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
M. E. Jennings.
IN: Urban Stormwater Hydrology, American Geophysical Union, Washington, DC. Water Resources Monograph 7, 1982. p 189-217, 4 fig, 4 tab, 23 ref.

Descriptors: *Hydrologic data collections, *Storm runoff, *Urban runoff, *Gaging stations, *Water quality, *Monitoring, *Urban hydrology, Urban drainage, Networks, Sewer hydraulics, Rainfall, Meteorological data collection, Streamflow, Land use, Rain gages, Sampling, Storm drains.

A data collection strategy which falls within the limits of economical, technical, and institutional constraints is an important planning prerequisite for an urban stormwater investigation. Two kinds of rainfall data are important for urban stormwater studies: at-site rainfall for calibration and verification of catchment response, and long-term rainfall for use if long-term simulations are required. A key variable in any urban stormwater investigation is stream discharge or stream stage. In recent years chemical and biological data are being collected as part of urban stormwater investigations. Land use characteristics should be updated during the course of urban runoff studies in order to account for changes occurring on the catchment. Two instrumentation systems are considered for urban stormwater investigations: a conventional urban (small catchment) gaging system and the USGS urban hydrology monitoring system. The gaging system, called the Urban Hydrology Monitoring System (UHMS) was specifically designed for flow gaging in undergroud storm sewers, using a flow constriction as a discharge control. The System Control Unit is a microprocessor based unit which records data at a central site, controls an automatic water-sampling device, records one or more rain gages via low-grade telephone lines, and continuously monitors stage. The remote recording rain gage, P 501-I is typically used with the UHMS. The atmospheric sampling subsystem collects rainfall and bulk precipitation samples. An advanced design atmospheric sampling subsystem, recently interfaced to the UHMS, is available from Aerochem Metrics. The UHMS has an optional underground storm sewer gaging control or constriction as a stage-sensing subsystem. A new instrument, the VMFM flow meter, based on a velocity-sensing technique using the electromagnetic principle has been developed by Marsh-McBirney, Inc. The UHMS water quality sampling subsystem is a modification of a Manning 4050 sequential sampler. Examples of data collection strategies for nine typical urban stormwater studies are discussed. (See also W87-09096) (Geiger-PTT)
W87-09103

NBS ENVIRONMENTAL STANDARD REFERENCE MATERIALS FOR USE IN VALIDATING WATER ANALYSIS,
National Bureau of Standards, Washington, DC. Office of Standard Reference Materials.
For primary bibliographic entry see Field 5A.
W87-09127

EMBANKMENT DAM INSTRUMENTATION MANUAL,
Colorado Univ. at Denver. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W87-09157

DETERMINATION OF TOXIC ORGANOPHOSPHORUS COMPOUNDS BY SPECIFIC AND NONSPECIFIC DETECTORS,
Army Medical Research Inst. of Chemical Defense, Aberdeen Proving Ground, MD.
For primary bibliographic entry see Field 5A.
W87-09220

ATTEMPT TO MEASURE THE FLOW OF CHLORINATED HYDROCARBONS, SUCH AS PCBS, FROM WATER TO AIR IN THE FIELD,
Inst. of Limnology, Univ. of Lund, Box 65, S-22100 Lund, Sweden.
P. Larsson, and L. Okla.
Environmental Pollution, Vol. 44, No. 3, p 219-225, 1987. 2 fig, 1 tab, 13 ref.

Descriptors: *Sampling devices, *Analytical methods, *Path of pollutants, *Volatilization, *Organochlorine compounds, *Polychlorinated biphenyls, Ponds, Water temperature, Measuring instruments, Hydrocarbons.

A field sampling device to study the transport of aromatic, persistent chlorinated hydrocarbons from water to air was constructed. It was tested in large, outdoor artificial ponds contaminated with polychlorinated biphenyls (PCBs). The PCB compounds volatilised to air at a rate of 0.9 to 9.6 ng/sq m/h depending on levels of PCBs in the water and water temperature. (Author's abstract)
W87-09246

STROBOSCOPIC DETERMINATION OF SETTLING VELOCITY, SIZE AND POROSITY OF ACTIVATED SLUDGE FLOCS,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
D.-H. Li, and J. J. Ganczarczyk.
Water Research WATRAG, Vol. 21, No. 3, p 257-262, March 1987. 5 fig, 16 ref. NSERC (Canada) Grant A7598.

Descriptors: *Measuring instruments, *Analytical methods, *Photography, *Settling velocity, *Stroboscopics, Flocculation, Porosity.

A multi-exposure photographic method was developed for the combined measurement of the settling velocity and size of activated sludge flocs. The proposed method mainly differs from the previous stroboscopic tests by introducing a new experimental arrangement which ensures sharp images of flocs on photographs. The relationships between individual floc-settling velocity and the floc size were found to be linear or fractional power functions. All these relationships were well correlated. Based on a simplified floc structure assumption and results of experimental measurements of floc-settling velocity and size, the floc porosity was determined. The porosity increased at two distinct rates as the floc size increased. (Author's abstract)
W87-09263

INSTRUMENTATION FOR ENVIRONMENTAL MONITORING, VOLUME 2: WATER,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5A.
W87-09303

STATISTICAL TECHNIQUES FOR EVALUATING PROCEDURES AND RESULTS FOR PERIPHYTON SAMPLING,
Water and Air Research, Inc., Gainesville, FL.
For primary bibliographic entry see Field 7C.
W87-09319

ROLE OF ELECTROFISHING IN ASSESSING ENVIRONMENTAL QUALITY OF THE WABASH RIVER,
DePauw Univ., Greencastle, IN. Dept. of Zoology.
For primary bibliographic entry see Field 5A.
W87-09328

ON-SITE OBSERVATIONS OF THE STATE OF STRUCTURES AT THE KANEV LOCK,
For primary bibliographic entry see Field 7A.
W87-09363

MEASUREMENT OF WATER POTENTIAL IN LOW-LEVEL WASTE MANAGEMENT,
Battelle Pacific Northwest Labs., Richland, WA.
T. L. Jones, G. W. Gee, R. R. Kirkham, and D. D. Gibson.
Available from the National Technical Information Service, Springfield, VA 22161, as DE83-001008, A04 in paper copy, A01 in microfiche. PNL-4388, August 1982. 52 p, 19 fig, 47 ref. Contract No. DE-AC06-76RLO 1830.

Descriptors: *Measuring instruments, *Water pollution control, *Soil water potential, *Water potentials, Tensiometers, Electrical resistance blocks, Sensors, Psychrometers, Heat dissipation probes, Monitoring, Hydraulic properties, Waste disposal, Radioactive waste disposal.

The measurement of soil water potential at waste management sites was studied. Several types of sensors (tensiometers, soil psychrometers, electrical resistance blocks, and heat dissipation probes) are available. For precise soil characterization studies the tensiometer is recommended; for long-term monitoring, the electrical resistance block. Tensiometers measure the soil water potential directly by measuring the soil water pressure. This is done by linking a pressure gage to a porous ceramic cup buried in the soil. Tensiometers have high precision (millibar) but limited range (0 to -0.8 bars). They perform best in loamy soils and are difficult to use in sandy soils. Electrical resistance blocks consist of two electrodes embedded in a porous material such as fiberglass or gypsum. When buried in the soil, the porous substance absorbs or loses water until the water potentials in the block and in the soil are equal. The electrical resistance measured between the electrodes is a measure of the water potential of the soil. Although a calibration procedure taking several months is required for each soil, no maintenance is required after installation. In addition, they have long-term stability, simple operation, and are relatively inexpensive. Fiberglass blocks are used in the range of -0.1 to -1 bar and gypsum in soils drier than -0.5 bars. All water potential sensors fail in frozen soil. (Cassar-PTT)
W87-09456

SURVEILLANCE, TRACKING, AND MODEL CORRELATION OF THE SPILL FROM THE TANKER BURMAH AGATE,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
F. J. Kelly, R. W. Hann, and H. N. Young.
IN: Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2-5, 1981, Atlanta, GA. p 147-152, 12 fig, 2 tab, 8 ref.

Descriptors: *Oil spills, *Oil slicks, *Distribution patterns, *Monitoring, *Texas, Oil tankers, Oil, Burmah Agate, Freeport.

The trajectory of the oil spilled from the tanker Burmah Agate passed through the extensively instrumented area of the U. S. Department of Energy Strategic Petroleum Reserve Brine Disposal Site off Freeport, Texas. Because of the potential impact of the spill on the 3-year baseline study, a major effort was made to monitor the slick movement, obtain samples, and collect and process oceanographic and meterological data. Daily reconnaissance flights were made by the authors to obtain VOR position fixes of oil patches and document them with 35mm and color video cameras. The orientation, centroid position, and velocity of the initial impulse of oil from the collision, which was tracked as far as San Jose Island, Texas, have been computed for the first 9 days. These results, as well as daily summaries are presented. Continuous measurements of near-surface currents at locations 6.5 and 11.5 nautical miles off Freeport, Texas and wind velocity at the 6.5-nautical mile location were also recorded, which provide a unique opportunity to correlate the oil movement with the traditional first-order approximation for oil transport. Good agreement between actual and predicted movements if found for the longshore component of motion, whereas the cross-shelf movement is not well predicted. The presence of a weak frontal zone in the coastal waters is suggested as a possible complicating factor. (Author's abstract)
W87-09520

7C. Evaluation, Processing and Publication

GENERALIZED METHOD OF MOMENTS AS APPLIED TO PROBLEMS OF FLOOD FREQUENCY ANALYSIS: SOME PRACTICAL RESULTS FOR THE LOG-PEARSON TYPE 3 DISTRIBUTION,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 2E.
W87-08616

UNSTEADY FLOW TO WELLS IN LAYERED AND FISSURED AQUIFER SYSTEMS,
Free Univ., Amsterdam (Netherlands). Inst. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W87-08618

REVIEW OF METHODS OF PARAMETER ESTIMATION FOR THE EXTREME VALUE TYPE-1 DISTRIBUTION,
University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
H. N. Phien.
Journal of Hydrology JHYDA7, Vol. 90, No. 3/4, p 251-268, April 1987. 6 tab, 23 ref, 2 append.

Descriptors: *Extreme value distributions, *Time series analysis, *Mathematical studies, *Statistics, *Data interpretation, *Estimating, *Distribution, *Mathematical equations, *Simulation, Performance evaluation, Parameters, Reviews.

Four important methods of estimating the parameters of the extreme value type-1 (Gumbel) distribution, namely: (1) moments (MMM); (2) maximum likelihood (MML); (3) maximum entropy (MME); and (4) probability weighted moments (PWM), are considered, suitable solution procedures are recommended and related problems discussed. Approximate formulae for computing the variances-covariances of the estimators by each method are given in terms of the population value of the scale parameter, and these are shown to indicate very well the performance of the related method. A simulation study to evaluate the performance of these methods in terms of commonly used criteria, i.e. the bias, root mean square error and goodness-of-fit statistic is described. It was found that the MMM is not as good as the remaining three methods, of which the PWM is best in terms of the bias, and the MML is best in terms of the root mean square error and efficiency. The MME, by all the criteria, ranks second best and follows the MML more closely than the PWM. (Author's abstract)
W87-08619

FINITE ELEMENT ANALYSIS OF WATER FLOW IN VARIABLY SATURATED SOIL,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W87-08620

ADVANTAGES OF USING REGRESSION ANALYSIS TO CALCULATE RESULTS OF CHRONIC TOXICITY TESTS,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5C.
W87-08650

INTRODUCTION TO GROUNDWATER MODELING: FINITE DIFFERENCE AND FINITE ELEMENT METHODS,
Wisconsin Univ.-Madison.
For primary bibliographic entry see Field 2F.
W87-08684

RAINFALL KINETIC ENERGY IN EASTERN AUSTRALIA,
Soil Conservation Service, Gunnedah (Australia).
For primary bibliographic entry see Field 2B.
W87-08698

ALTERNATE PROCEDURE FOR ANALYZING AQUIFER TESTS USING THE THEIS NONEQUILIBRIUM SOLUTION,
City Coll., New York. Dept. of Earth and Planetary Sciences.
O. L. Franke.
Ground Water GRWAAP, Vol. 25, No. 3, p 314-320, May-June 1987. 5 fig, 1 tab, 10 ref.

Descriptors: *Pumping tests, *Data interpretation, *Aquifer tests, *Theis nonequilibrium solution, Confined aquifers, Curve matching, Estimating, Field tests.

A classical dimensional analysis of the Theis nonequilibrium radial flow problem in a confined aquifer indicates that three dimensionless parameters are required for its representation. A new set of type curves based on three dimensionless parameters sT/Q, Qt/sr squared, and S, is developed that can be employed to analyze aquifer test data by a curve-matching procedure similar to the procedure used at present with two dimensionless variables. The possible advantages of the proposed new type curves are as follows: (1) The concave shape of the type curves alone the x-axis and particularly their point of vertical tangency permits curve matching with a minimum of ambiguity. Furthermore, the possibility of gross errors in the curve-matching procedure is reduced because both type curves and the plot of field data use the same dimensionless parameter on the horizontal axis (x-axis) so that the process of curve matching permits movement of the field curve only parallel to the vertical axis (y-axis). (2) The shape of the proposed type curves provides a focus for aquifer-test design - that is, given very approximate estimates for the field parameters (T and S), the investigator can target a

specific range for the field-measured parameters for which curve matching will give best possible results. (Author's abstract)
W87-08756

IMPACT OF THE DUPUIT-FORCHHEIMER APPROXIMATION ON SALT-WATER INTRUSION SIMULATION,
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 2F.
W87-08758

PREDICTIVE APPLICATION OF AN ORNL GEOHYDROLOGY MODEL,
Miami Univ., FL. Dept. of Mechanical Engineering.
K.-F. V. Wong, G. T. Yeh, and E. C. Davis.
Ground Water GRWAAP, Vol. 25, No. 3, p 342-345, May-June 1987. 6 fig, 7 ref. DOE Contract DE-AC05-840R21400.

Descriptors: *Geohydrology, *Water levels, *Drawdown, *Groundwater, *Model studies, *ORNL model, *Aquifer testing, *FEWA, *Computer programs, Biscayne aquifer, Florida, Prediction, Calibrations, Wells, Rainfall, Infiltration, Recharge.

The purpose of this work is to demonstrate the predictive capability of the Oak Ridge National Laboratory finite-element computer model of water flow through aquifers, FEWA. The computer code for FEWA was written by G. T. Yeh and D. D. Huff. The area investigated was the Hialeah-Preston wells in Miami, Florida over the Biscayne aquifer. The field data of May 3, 1977, for the area were used for calibration of the model. The model was then integrated over time until October 4, 1977, using the data on rainfall, infiltration, and pumpage of wells during that period. The predicted potentiometric head for the area compared well with the field data. It may be concluded that substantial confidence in the predictive capability of the model has been established for the site in Florida. (Author's abstract)
W87-08760

ANALYSIS OF HORIZONTALLY TWO-DIMENSIONAL MORPHOLOGICAL EVOLUTIONS IN SHALLOW WATER,
Waterloopkundig Lab. te Delft (Netherlands).
H. J. De Vriend.
Journal of Geophysical Research (C)JGRCEY, Vol. 92, No. 4, p 3877-3893, April 1987. 13 fig, 38 ref, 2 append.

Descriptors: *Channel morphology, *Sedimentation, *Data interpretation, *Model studies, *Mathematical models, *Bed evolution, *Shallow water, *Water currents, *Sediment transport, Field tests, Calibrations.

A system of depth-integrated equations, form a rather primitive mathematical model of horizontally two-dimensional (2DH) bed evolutions in shallow water. The model was analyzed using characteristics theory. The solution of this system exhibits an essentially two-dimensional propagation character, with bottom disturbances traveling in other directions than the current velocity and the sediment transport. The results of this analysis are verified by numerical experiments and interpreted physically. Their relevance for numerical modeling of 2DH morphological processes in shallow water is discussed, and their occurrence and recognizability in natural situations is checked by a qualitative comparison with field observations.
W87-08782

RAINFALL PATTERN ASSOCIATED WITH A SPLIT COLD FRONT AS SEEN ON FRONTIERS,
Meteorological Office, Bracknell (England).
For primary bibliographic entry see Field 2B.
W87-08800

HYDROLOGICAL MAPS: DEVELOPMENT OF A SYSTEM FOR CALCULATION AND PRESENTATION,
Sveriges Meteorologiska och Hydrologiska Inst., Norrkoeping.
B. Johansson, and T. Jutman.
Nordic Hydrology NOHYBB, Vol. 17, No. 4/5, p 229-236, 1986. 6 fig, 2 tab, 9 ref.

Descriptors: *Maps, *Information systems, *Hydrologic maps, *Hydrologic data, *Data presentation, *Data interpretation, Mathematical equations, Planning, Hydrologic information, Mathematical models, Model studies.

Increasing attention is paid to problems concerning water resources planning. It is essential that the hydrological information required is available to the planner in a form that facilitates combination with other types of information. The development of a system for calculation and presentation of regional and comprehensive hydrological information is described. Main components of the system are the interpolation routines, a water balance model adapted to the space and time scale and a data base for supporting information. Examples of presentations are given. (Author's abstract)
W87-08812

CORRECTION OF LIQUID PRECIPITATION,
Danish Meteorological Inst., Copenhagen.
For primary bibliographic entry see Field 2B.
W87-08813

WATBAL: A SEMI-DISTRIBUTED, PHYSICALLY BASED HYDROLOGICAL MODELLING SYSTEM,
Danish Hydraulic Institute, Horsholm.
For primary bibliographic entry see Field 2G.
W87-08823

OPERATIONAL SPRING TIME FORECASTING DIFFICULTIES AND IMPROVEMENTS,
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 2E.
W87-08824

TRANSFORMATION OF INPUT TO A STOCHASTIC MODEL USING A DISTRIBUTION DETERMINISTIC MODEL,
National Energy Authority, Reykjavik (Iceland).
For primary bibliographic entry see Field 2E.
W87-08825

STATISTICAL ASSESSMENT OF A SAMPLING PATTERN FOR EVALUATION OF CHANGES IN MERCURY AND ZINC CONCENTRATIONS IN PATELLA COERULEA,
Institut National de la Sante et de la Recherche Medicale, Nice (France).
For primary bibliographic entry see Field 5A.
W87-08884

EMPIRICAL PREDICTION OF THE SUMMER MONSOON RAINFALL OVER INDIA,
Maryland Univ., College Park. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W87-08940

ESTIMATING BASEFLOW VOLUME AND ITS UNCERTAINTY,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2E.
W87-08971

GEOGRAPHIC INFORMATION SYSTEM TO PREDICT NON-POINT SOURCE POLLUTION POTENTIAL,
Nebraska Univ.-Lincoln. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W87-08977

ALTERNATIVE DEMAND MODEL ESTIMATORS FOR BLOCK RATE PRICING,
Arizona Univ., Tucson. Dept. of Economics.
For primary bibliographic entry see Field 6C.
W87-08984

SOLUTE TRANSPORT DURING ABSORPTION AND INFILTRATION: A COMPARISON OF ANALYTICAL APPROXIMATIONS,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
D. E. Elrick, B. E. Clothier, and J. E. Smith.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 282-287, March-April 1987. 4 fig, 1 tab, 26 ref.

Descriptors: *Solute transport, *Data interpretation, *Model studies, *Soil water, *Path of pollutants, *Absorption, *Infiltration, Prediction, Salts.

Several analytical solutions of one-dimensional solute transport during infiltration have been reported. This study links these solutions by starting with the exact integral solution, followed by successive approximations in order to arrive at the simplest approximate solution. A number of planes of separation are defined and the physical significance of these planes is discussed using model soil water profiles. The retardation effect of adsorbed chemicals, such as many fertilizers and pesticides, can easily be included in the analysis when the partition coefficient is known. Experimental and predicted absorption and infiltration profiles of KCl into Brookston silty clay loam (Orthic Humic Gleysol (Can.), Typic Haplaquolls (USA)) compared favorably using the simplest (field applicable) approximation. (Author's abstract)
W87-08990

ELIMINATION OF TIME ASSIGNMENT BIAS IN ESTIMATES OF DISPERSION COEFFICIENT,
Science and Education Administration, University Park, PA. Northeast Watershed Research Center.
R. R. Schnabel, and E. B. Richie.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 2, p 302-304, March-April 1987. 1 fig, 2 tab, 7 ref.

Descriptors: *Path of pollutants, *Dispersion coefficients, *Regression analysis, *Effluents, *Transport equations, *Model studies, *Data interpretation, Soil water, Solutes, Transport, Estimating, Prediction.

Dispersion coefficients are commonly determined by regressing column effluent data against predictions of transport equations. When column effluent is collected in fractions, measured concentration is an average over the collection interval. A method is presented for estimating dispersion coefficients by regressing column data against the integral of the transport equation. This dispersion coefficient is compared to estimates obtained when effluent concentration is assigned to the end or middle of collection intervals. Dispersion coefficient estimates obtained by regressing effluent concentration against the integral of the transport equation were as much as 80% greater than those obtained by assigning effluent concentration to the end of the collection interval, and within approximately 20% of those obtained by assigning effluent data to the middle of the interval. The amount of difference depended on model variables of collection interval and Peclet number. (Author's abstract)
W87-08994

CAPILLARITY CORRECTION FOR FREE SURFACE FLOW OF GROUNDWATER,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2F.
W87-09018

QUASI-SOLUTION OF RICHARDS' EQUATION FOR THE DOWNWARD INFILTRATION OF WATER INTO SOIL,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W87-09019

RADAR RAINFALL DATA QUALITY CONTROL BY THE INFLUENCE FUNCTION METHOD,
National Weather Service, Silver Spring, MD. Hydrologic Research Lab.
W. F. Krajewski.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 837-844, May 1987. 4 fig, 7 tab, 14 ref.

Descriptors: *Data interpretation, *Influence function method, *Statistical analysis, *Radar, *Rainfall, Monte Carlo method, Comparison studies, Performance evaluation.

The statistical concept of the influence function is applied to detection of outliers in radar rainfall fields. The method can identify observations which are inconsistent with the spatial correlation in the field. A Monte Carlo experiment has been performed to test the method for daily and hourly radar rainfall data and to compare it to other simple methods such as range and gradient checks. The results of that study indicate the usefulness of the method in the detection of outliers in real time. They also show the potential of the method to deal with outliers resulting from certain types of anomalous propagation. (Author's abstract)
W87-09022

ERROR ANALYSIS OF CONVENTIONAL DISCRETE AND GRADIENT DYNAMIC PROGRAMMING,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
P. K. Kitanidis, and E. Foufoula-Georgiou.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 845-858, May 1987. 7 fig, 31 ref, append. NSF Grants CEE-8212066 and CEE-8420664.

Descriptors: *Decision making, *Data interpretation, *Dynamic programming, *Error analysis, Discretization, Interpolation, Estimating.

An asymptotic error analysis of the conventional discrete dynamic programming (DDP) method is presented, and upper bounds of the error in the control policy (i.e., the difference of the estimated and true optimal control) at each operation period are computed. This error is shown to be of the order of the state discretization interval (DeltaS), a result with significant implications in the optimization of multistate systems where the 'curse of dimensionality' restricts the number of states to a relatively small number. The error in the optimal cost varies with DeltaS squared. The analysis provides useful insights into the effects of state discretization on calculated control and cost functions, the comparability of results from different discretizations, and criteria about the required number of nodes. In an effort to reduce the discretization error in the case of smooth cost functions, a new discrete dynamic programming method, termed gradient dynamic programming (GDP), is proposed. GDP uses a piecewise Hermite interpolation of the cost-to-go function, at each stage, which preserves the values of the cost-to-go function and of its first derivatives at the discretization nodes. The error in the control policy is shown to be of the order of (DeltaS cubed) and the error in the cost to vary with DeltaS to the 4th power. Thus as DeltaS decreases, GDP converges to the true optimum much more rapidly than DDP. Another major advantage of the new methodology is that it facilitates the use of Newton-type iterative methods in the solution of the nonlinear optimization problems at each stage. The linear convergence of DDP and the superlinear convergence of GDP are illustrated in an example. (Author's abstract)
W87-09023

MARKOV RENEWAL MODEL FOR RAINFALL OCCURRENCES,
Iowa State Univ., Ames. Dept. of Civil Engineering.
E. Foufoula-Georgiou, and D. P. Lettenmaier.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 875-884, May 1987. 2 fig, 10 tab, 34 ref, append.

Descriptors: *Data interpretation, *Model studies, *Probabilistic process, *Rainfall, *Precipitation, Markov chain, Distribution.

A probabilistic model for the temporal description of daily rainfall occurrences at a single location is presented. By defining an event as a day with measurable precipitation the model is cast into the discrete-time point process framework. In the proposed model the sequence of times between events is formed by sampling from two geometric distributions, according to transition probabilities specified by a Markov chain. The model belongs to the class of Markov renewal processes and exhibits clustering relative to the independent Bernoulli process. As a special case, it reduces to a renewal model with a mixture distribution for the interarrival times. The rainfall occurrence model coupled with a mixed exponential distribution for the nonzero daily rainfall amounts was applied to the daily rainfall series for Snoqualmie Falls, Washington, and was successful in preserving the short-term structure of the occurrence process, as well as the distributional properties of the seasonal rainfall amounts. (Author's abstract)
W87-09025

STATISTICAL MODELING OF DAILY RAINFALL OCCURRENCES,
Interstate Commission on the Potomac River Basin, Rockville, MD.
J. A. Smith.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 885-893, May 1987. 2 fig, 2 tab, 13 ref, append.

Descriptors: *Data interpretation, *Model studies, *Probabilistic process, *Rainfall, *Precipitation, Markov chain, Distribution.

Likelihood-based inference procedures for discrete point process models are developed, and a new family of discrete point process models for daily rainfall occurrences is proposed. The model, which is termed a Markov Bernoulli process, can be viewed as a sequence of Bernoulli trials with randomized success probabilities. Contained within the family of Markov Bernoulli models are Markov chain and Bernoulli trial models. Asymptotic properties of maximum likelihood estimators of Markov Bernoulli model parameters estimators and for developing likelihood ratio tests to choose among Markov Bernoulli, Markov chain, and Bernoulli trial models. Inference procedures are applied to a data set from Washington, D.C. (Author's abstract)
W87-09026

STATISTICAL STRUCTURE AND FILTER CHARACTERISTICS OF TRITIUM FLUCTUATIONS IN FRACTURED BASALT,
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W87-09027

ROBUST-RESISTANT SPATIAL ANALYSIS OF SOIL WATER INFILTRATION,
Iowa State Univ., Ames. Dept. of Statistics.
N. A. C. Cressie, and R. Horton.
Water Resources Research WRERAQ, Vol. 23, No. 5, p 911-917, May 1987. 6 fig, 34 ref. NSF Grant DMS-8503693.

Descriptors: *Data interpretation, *Spatial variation, *Soil water, *Infiltration, Estimating, Geostatistics, Hydrology, Tillage effects, Semivariograms.

Data taken at adjacent spatial locations often exhibit correlation which must be taken into account in their analysis. Geostatistical methods, originally developed for the mining industry, have proven to be adaptable to hydrological problems. This paper concentrates on estimating the spatial correlations between soil water infiltration observations, with special emphasis on resistant methods to remove nonstationarity. After this removal, robust semivariogram estimators are used to examine the spatial dependencies for various tillage treatments. There is some indication that infiltration characteristics inherit different types of spatial dependency, depending on the tillage treatment applied. (Author's abstract)
W87-09029

SIMULATION OF THE BORDEN PLUME USING THE ALTERNATING DIRECTION GALERKIN TECHNIQUE,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W87-09030

OVERVIEW OF URBAN STORMWATER MODELS,
Camp, Dresser and McKee, Inc., Annandale, VA.
For primary bibliographic entry see Field 4C.
W87-09104

MODELING THE FLOW OF IMMISCIBLE FLUIDS IN SOILS,
Dept. of Soil Science, National Chung Hsing Univ., Taichung, Taiwan, Republic of China.
For primary bibliographic entry see Field 2G.
W87-09258

SAFETY FACTOR FOR LC50 VALUES ALLOWING FOR DIFFERENCES IN SENSITIVITY AMONG SPECIES,
Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Delft (Netherlands).
For primary bibliographic entry see Field 5C.
W87-09266

STATISTICAL ANALYSIS,
Harvard Univ. School of Public Health, Boston, MA. Dana Farber Cancer Inst.
For primary bibliographic entry see Field 5C.
W87-09284

BASIC SOIL MECHANICS,
Oxford Univ. (England). Dept. of Engineering Science.
For primary bibliographic entry see Field 8D.
W87-09307

STATISTICAL TECHNIQUES FOR EVALUATING PROCEDURES AND RESULTS FOR PERIPHYTON SAMPLING,
Water and Air Research, Inc., Gainesville, FL.
J. H. Sullivan, H. D. Putnam, J. T. McClave, and D. R. Swift.
IN: Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms, A Symposium Sponsored by ASTM Committee D-19, Ft. Lauderdale, FL, 29-30 January 1979. ASTM STP 730, 1981. p 132-141, 3 fig, 3 tab, 3 ref. DOA Contract DAMD-17-75-C-5049.

Descriptors: *Testing procedures, *Water quality, *Performance evaluation, *Statistical methods, *Periphyton, Sampling, Industrial wastes, Water quality control, Population density, Ecosystems, Aquatic environment, Effluents.

Statistical procedures for evaluating periphyton sampling techniques and results are described. The sampling technique utilized was glass slides incubated at various locations in a reservoir receiving industrial effluent. The density, diversity, and dominance of organisms were utilized as dependent variables. Initially, the sampling and processing technique was evaluated to determine the variability at each step. From this information, decisions were made regarding where in the process replication would be most important. Further, statistical procedures are demonstrated for relating sampling replication to the ability to detect differences between results obtained at different sampling locations. Techniques for relating processing or counting effort to the reliability of estimates of dominant species are discussed. The statistical techniques illustrated can be used to relate overall sampling or processing effort or costs to the reliability of the final results. (See also W87-09311) (Author's abstract)

W87-09319

STATE OF THE ENVIRONMENT, 1985.
Organization for Economic Co-Operation and Development, Paris (France).
For primary bibliographic entry see Field 6G.
W87-09336

CONFORMAL-MAPPING TECHNIQUE FOR TOPOGRAPHIC-WAVE PROBLEMS: SEMI-INFINITE CHANNELS AND ELONGATED BASINS,
JISAO, Univ. of Washington, Seattle, WA 98195, USA.
E. R. Johnson.
Journal of Fluid Mechanics JFLSA7, Vol. 177, p 395-405, April 1987. 7 fig, 5 ref. DOE Grant NA85ABH00031; NSF Grant CE84-45194.

Descriptors: *Data interpretation, *Hydrodynamics, *Conformal-mapping technique, *Waves, Topography, Channels, Flow, Equations.

The basis of the conformal-mapping method for topographic-wave problems of Johnson (1985) is discussed in greater detail by considering the invariance under conformal mapping of the linear, barotropic, potential-vorticity equation, noted in Davis (1983). A method is presented for using this property to construct further solutions for waves propagating over varying topography. Results are given for semi-infinite channels and elongated basins. A coordinate system is constructed that approaches a Cartesian system exponentially fast with distance from end-walls. For exponentially sloping topography the solutions for infinite channels, semi-infinite channels, and basins have the same structure and dispersion relation as waves in an elliptical basin, discussed in Johnson (1987). The structures presented there can thus be considered as in some sense universal for exponentially sloping topography. (Author's abstract)
W87-09384

SCANNING CURRENTS IN STOKES FLOW AND THE EFFICIENT FEEDING OF SMALL ORGANISMS,
New York Univ., NY. Courant Inst. of Mathematical Sciences.
For primary bibliographic entry see Field 2H.
W87-09385

INTERACTIVE COMPUTER-AIDED WATER RESOURCES AND ENVIRONMENTAL PLANNING USING COLOR RASTER GRAPHICS: PROGRAM DESCRIPTION AND USER'S GUIDE,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
P. N. French, M. R. Taylor, and D. P. Loucks.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-169250, A09 in paper copy, A01 in microfiche. December 15, 1982. 198 p, 6 fig, 3 tab.

Descriptors: *Water resources development, *Resources development, *Water management, Water quality, Water quality control, Model studies, Data processing, Data storage and retrieval, Data interpretation, Computers, Computer programs, Graphical methods.

Computer-aided planning (CAP) programs, which provide for the inputting of spatial geographical data and other graphic and alphanumeric data as well as for the editing and analyzing of these data, are discussed. The general structure of CAP programs and associated computer equipment is revealed, as are elements of computer graphics. A general overview of the CAP program, including initial procedures for establishing directories, compiling and linking the required modules, and running the programs, is presented. Operation procedures are examined. A data sheet for each CAP menu page subprogram is supplied and a series of examples illustrates how a user can access or perform a particular task. (Author's abstract)
W87-09426

FOCUS: FISHERIES OCEANOGRAPHY COOPERATIVE USERS SYSTEM,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
D. C. McConaghy, M. J. McPhail, P. D. Moen, and K. S. Parker.
NOAA Technical Memorandum ERL PMEL-50, October 1983. 74 p, 7 fig, 11 ref, 5 append.

Descriptors: *Fish management, *Data bases, *Fishery data, *Alaska, *Fisheries, *Oceanography, *Computer programs, *Data processing, *Environmental effects, Bering Sea, Gulf of Alaska, Marine resources, Marine fisheries, FOCUS computer program, Meterological data collection, Data collections, Statistical analysis, Fish eggs, Spawning, Pollock, Crabs, Shelikof Strait, Alaska.

A user friendly data base management system, FOCUS (Fisheries Oceanography Cooperative Users System), has been developed for use in investigations on ocean-fishery variability and interactions in the Bering Sea and Gulf of Alaska. This system offers the ability to associate, join and directly analyze two or more data types from various environmental and fisheries data sets and computer systems. Data may be obtained as statistical summaries, time series plots, contour plots, and other integrated data analyses. The major data systems are R2D2, RACEBASE, and METLIB. Two examples are described: (1) an analysis of the relationship between hydrography and pollock egg distributions in the Shelikof Strait and (2) the relationship between degree days (an indicator of bottom temperature) and the abundance of four-year-old crabs. (Cassar-PTT)
W87-09500

DATA INTERCOMPARISON THEORY I. MINIMAL SPANNING TREE TESTS FOR LOCATION AND SCALE DIFFERENCES,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
R. W. Preisendorfer, and C. D. Mobley.
NOAA Technical Memorandum ERL PMEL-38, December 1982. 48 p, 13 fig, 2 tab, 10 ref, 4 append.

Descriptors: *Date processing, *Temperature, *Climatology, *Seasonal variation, *Meterological data collection, Minimal spanning tree test, Variability, Graphical analysis, Statistical analysis, Mathematical studies.

The minimal spanning tree (MST) scale test was applied to a problem of defining natural seasons over the U.S. mainland, using a 46-year temperature record, 1931-1976, from 32 cities. The 12 months were partitioned into new seasons based on months with comparable temperature variances. The MTS concept was derived from the union of the data sets (n samples of some field at p points in space) when they were considered as n-point swarms in euclidean p-space. The MST test is the network of straight lines in euclidean p-space that connects the points of the pooled swarms with the least possible total length of its segments. The test of relative location of data sets based on the MST uses a generalized notion of 'run,' (which measures how much the points of the two sets intermingle in their MST) while the scale test for variance is based on the simple intuitive idea that the set with greater variance has the branches of its part of the tree spread beyond those of the other. The MST test was compared with variance calculations of the classical form. It is concluded that the MST scale test is relatively powerful and useful. (Cassar-PTT)
W87-09501

DATA INTERCOMPARISON THEORY V. CASE STUDY: EFFECTS OF OBJECTIVE ANALYSIS ON A TROPICAL PACIFIC SEA SURFACE TEMPERATURE SET,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
R. W. Preisendorfer, and C. D. Mobley.
NOAA Technical Memorandum ERL PMEL-42, December 1982. 82 p, 40 fig, 11 tab, 5 ref, append.

Descriptors: *Date processing, *Climatology, *Meterological data collection, *Statistical analysis, Variability, Temperature, Mathematical studies, Water temperature, Pacific Ocean, Oceanography, Tropical regions.

A study was made of an objective analysis scheme by Liu which has SST-gradient-dependent smoothing and correction operations, along with data-weight and outlier cutoff features. This scheme is an elaboration of that originally devised by Cressman and subsequently expanded by Levitus and Oort. The object of the study is to apply certain new data intercomparison techniques (developed in the four earlier works of the present series) to the data set produced by Liu's scheme, with the goal in mind to determine how the various features of the new objective analysis scheme change the location (average), scale (variance), and pattern properties of the data set. In general it was found that the average properties of a data set are largely unchanged by application of the above feature of Liu's scheme. However, the variance and pattern properties are significantly changed by the various smoothing operations in Cressman-type objective analysis schemes. In the case of Liu's data set the changes are by amounts (0.5 degrees C) that are climatologically important. Thus a new objective analysis scheme may significantly affect location, scale and pattern properties of a data set, and therefore in ways that could affect the formation and verification of hypotheses of climatic change. (Author's abstract)
W87-09502

DATA INTERCOMPARISON THEORY IV. TERCILE TESTS FOR LOCATION, SPREAD AND PATTERN DIFFERENCES,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
R. W. Preisendorfer, and C. D. Mobley.
NOAA Technical Memorandum ERL PMEL-41, December 1982. 48 p, 11 fig, 2 tab, 6 ref, append.

Descriptors: *Data processing, *Climatology, *Meterological data collection, *Statistical analysis, *Tercile method, Variability, Mathematical studies, Prediction, Stochastic analysis.

The tercile (Trinomial Stochaster) technique was used to examine two data sets for closeness. In this technique, over a given set of points in space, the two fields have their 0-class, 1-class, and 2-class errors tallied and examined for statistical significance. The class errors were used to gage the closeness of the three main attributes of the data sets: locations (averages), spreads (variance), and patterns (spatial or temporal). The tercile technique was applied to three problems: (1) gaging the effects of different objective analysis methods on the same raw data set, (2) examining the self-predictability of a data set, and (3) devising a new principal-component selection rule using the concept of self-predictability. (Cassar-PTT)
W87-09503

DATA INTERCOMPARISON THEORY II. TRINITY STATISTICS FOR LOCATION, SPREAD AND PATTERN DIFFERENCES,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
R. W. Preisendorfer, and C. D. Mobley.
NOAA Technical Memorandum ERL PMEL-39, December 1982. 94 p, 30 fig, 6 tab, 8 ref, append.

Descriptors: *Data processing, *Climatology, *Meterological data collection, *Statistical analysis, *Multivariate analysis, Variability, Mathematical studies, SITES statistics, SHAPE statistic, SPRED statistic.

Three basic measures of data set separation and procedures for assigning statistical significance to these measures were examined. The three measures were for distances between (1) means (SITES), (2) variances (SPRED). and (3) patterns (SHAPE) of space-time geophysical multivariate data sets. The

patterns were resolved into spatial and temporal patterns. Procedures to generate reference distributions, by which statistical significance is decided, were determined according to the amount of data available: adequate, semi-adequate, borderline, semi-inadequate, and inadequate. Procedures to generate reference distributions for SITES and SPRED were developed for each category. Power curves were compared with those generated by some classical tests for relative location and spread of multivariate data sets. SPRED and SITES appeared to be relatively useful. (Cassar-PTT)
W87-09504

DATA INTERCOMPARISON THEORY III. S-PHASE AND T-PHASE TESTS FOR SPATIAL PATTERN AND TEMPORAL EVOLUTION,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
R. W. Preisendorfer, and C. D. Mobley.
NOAA Technical Memorandum ERL PMEL-40, December 1982. 123 p, 19 fig, 2 tab, 5 ref, 5 append.

Descriptors: *Data processing, *Climatology, *Meterological data collection, *Statistical analysis, *Multivariate analysis, Variability, Mathematical studies, SHAPE statistic, Spatial distribution, Temporal distribution.

A set of statistics, which describe differences in spatial patterns and temporal evolutions of data sets, were derived from the SHAPE (distances between patterns) statistic of a related study. SHAPE and its derivatives were correlational, which permitted immediate statistical significance tests using existing tables. Since the correlation-type statistics were limited in their ability to discern differences in spatial and temporal patterns of data sets, two multiparameter tests were devised: S-phase, based on the canonic rotation angles between the spatial frames of two data sets that have been given their singular value decomposition; and T-phase, based on the canonic correlation angles between the temporal frames of two data sets under the same type of decomposition. The multiparameter tests performed well under realistic data conditions but were difficult to interpret. (Cassar-PTT)
W87-09505

BRITISH EXAMPLES OF A HYDROGEOLOGICAL APPROACH TO THE EVALUATION OF DRAINAGE PROBLEMS IN SUBSURFACE ENGINEERING,
Institute of Geological Sciences, London (England).
For primary bibliographic entry see Field 2F.
W87-09593

8. ENGINEERING WORKS

8A. Structures

2-D ELASTOPLASTIC SEISMIC SHEAR RESPONSE OF EARTH DAMS: THEORY,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Civil Engineering.
A.-W. M. Elgamal, A. M. Abdel-Ghaffar, and J.-H. Prevost.
Journal of Engineering Mechanics JENMDT, Vol. 113, No. 5, p 689-701, May 1987. 5 fig, 23 ref. NSF Grant CEE-8120757.

Descriptors: *Earthquakes, *Earth dams, *Numerical analysis, *Model studies, *Shear response, *Seismic shear, Shear, Dams, Equations, Costs.

A simplified analytical-numerical method for analyzing the nonlinear earthquake response of earth dams, modeled as two-dimensional, nonhomogeneous shear wedges in rectangular canyons, is presented. The method takes into account the nonlinear, hysteretic, and strain-dependent characteristics of the dam materials. The hysteretic stress-strain behavior of the material is modeled using elasto-plastic constitutive equations based on multisurface kinematic plasticity theory; no viscous or numerical (artificial) damping is employed. The method is based on a Galerkin formulation of the equation of motion in which the solution is expanded using the eigenmodes of the two-dimensional linearized problem defined over the spatial domain occupied by the dam. The analysis can be used to calculate the entire time history of the response quantities, including permanent deformations of earth dams subjected to ground shaking. Finally, the efficiency and low computational cost make the technique very attractive. (See also W87-08608) (Author's abstract)
W87-08607

2-D ELASTOPLASTIC SEISMIC SHEAR RESPONSE OF EARTH DAMS: APPLICATIONS,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Civil Engineering.
A.-W. M. Elgamal, A. M. Abdel-Ghaffar, and J.-H. Prevost.
Journal of Engineering Mechanics JENMDT, Vol. 113, No. 5, p 702-719, May 1987. 12 fig, 7 tab, 8 ref.

Descriptors: *Comparison studies, *Earthquakes, *Earth dams, *Numerical analysis, *Model studies, *Shear response, *Seismic shear, Shear, Dams, Equations, Costs.

A method is presented to analyze the nonlinear earthquake response of an earth dam; the entire time history of the response quantities, including permanent deformation of the dam, is calculated. Two different input ground motion cases are considered: a moderate and strong shaking with very different frequency characteristics. Comparative studies are conducted to examine the influence of two-dimensionality, nonlinearity, nonhomogeneity, modal expansion, modal coupling, and the multidimensional stress interaction on the response. The results are also compared to those obtained by an elaborate finite element analysis. The comparative study reveals significant response differences between one- and two-dimensional analyses, homogeneous and nonhomogeneous models, moderate and strong shakings, and one- and multi-mode solution expansions. In addition, the comparison indicates that the simplified method proposed can be used to reliably estimate the nonlinear earthquake response of earth dams modeled as 2-D shear wedges. (See also W87-08607) (Author's abstract)
W87-08608

ENGINEERING MEASURES: WATERWAYS AND DIVERSION CHANNELS,
Finkel and Finkel, Yoqneam (Israel).
H. J. Finkel.
IN: Semiarid Soil and Water Conservation, CRC Press, Inc., Boca Raton, FL. 1986. p 75-84, 7 fig, 1 tab, 4 ref.

Descriptors: *Structural engineering, *Waterways, *Diversion channels, *Water conservation, Cultivation, Agriculture, Economic aspects, Hydraulic structures.

There is a certain logical order in applying soil and water conservation measures to cultivated fields, proceeding from the simple and less expensive to the more complex and expensive. Only where the lesser measures are inadequate are the greater measures added. Note the word 'added'. The engineering measures are not a substitute for agronomic measures, but should be superimposed upon them. A full program begins with correct land use (insofar as economic realities permit), proceeds to selection of allowable intensity of rotation, and is followed by contour farming, with strip cropping where needed. All of these measures are within the farmer's ability to establish alone, with the advice of a competent farm planner and a bit of technical help. If all of these practices are not sufficient, the farmer must turn to the engineering measures which require a somewhat higher level of technical assistance, and are more costly. These measures are, in themselves, graduated from the simpler to the more complex, and should be applied in that order, which is more or less the sequence of the presentation in this paper. (See also W87-08661) (Lantz-PTT)
W87-08666

DEFENDING OUR LAKESHORES,
For primary bibliographic entry see Field 4D.
W87-08674

GEOTECHNICAL ASPECTS OF CORANI RESERVOIR ENLARGEMENT,
Monenco Consultants Ltd., Montreal (Quebec).
J. A. Code, and M. Afif.
Canadian Geotechnical Journal CGJOAH, Vol. 24, No. 1, p 35-44, February 1987. 15 fig, 1 tab, 6 ref.

Descriptors: *Reservoir enlargement, *Hydraulic structures, *Construction, *Diversion structures, *Corani reservoir, *Canal construction, *Tunnel construction, Tunnels, Canals, Reservoirs, Bolivia, Dam design, Dam construction, Diversion, Grouting, Shales, Spillways, Quartz, Construction materials, Construction methods.

The geotechnical aspects of a reservoir enlargement project located in the headwaters of the Amazon Basin, in the Andean Cordillera of central Bolivia, were described. This reservoir serves the Corani and Santa Isabel hydroelectric stations, which harness in sequence 1409 meters of head below reservoir level. The project involved raising the existing Corani dam and constructing a diversion scheme to convey water from the adjacent Malaga River watershed into the enlarged reservoir. The Corani dam was raised 5 meters by adding a zoned earth-rockfill section to the existing embankment dam and constructing a concrete overflow spillway that incorporated the existing masonry structure. The Malaga diversion scheme involved construction of four intakes, 1.7 kilometers of canals, and 12.1 kilometers of tunnels. The tunnels were driven through a wide variety of rock types ranging from good-quality quartzites to squeezing shales. The project was completed in 1984. Design features, construction materials and methods, and performance were detailed for the dam, canals and tunnels. (Wood-PTT)
W87-08794

PREDICTING SETTLEMENT AT A DAMSITE ON A TUNNEL VALLEY DEPOSIT IN ALBERTA,
Alberta Environment, Edmonton.
J. E. McClung, and J. D. Mollard.
Canadian Geotechnical Journal CGJOAH, Vol. 24, No. 1, p 45-57, February 1987. 10 fig, 2 tab, 16 ref.

Descriptors: *Damsites, *Subsidence, *Soil mechanics, *Hydraulic structures, *Sedimentation, Valleys, Alberta, Sand River, Silts, Sediments, Silica, Sand, Glacial sediments, Prediction.

During investigations for a damsite on the Sand River, Alberta, an 80 meter thick silt deposit in a valley approximately 500 meters across was encountered. The most distinctive feature of the deposit is the uniformity of the silt, with thickness of up to 50 meters occurring as a single layer uninterrupted by seams of significantly different material. The silt is believed to be the result of very uniform, prolonged depositional conditions in a subglacial river. The silt consists largely of silical grains between 10 and 60 micron and although it contains clay, in some aspects its behavior os close to that of sand. Evidence suggests that the present valley is a tunnel valley formed by meltwaters flowing through the underside of the glacier. The implications for the engineering geology of the damsite investigated are discussed and some geotechnical properties of this unusual silt deposit are presented, particularly as they affect settlement prediction. It was concluded that, although it was possible to drill 70 meters into the silt with an auger drill, the degree of disturbance of the oedometer samples generally increased with depth. Because the silt was deposited uniformly, the average value of the compression index as determined by the oedometer test could be checked by fitting a curve to the relationship between void ratio and geostatic load in order to increase confidence in the calculated settlement predictions. (Wood-PTT)
W87-08795

GROUNDWATER MODELLING FOR HYDROPOWER DEVELOPMENT IN ICELAND,
VST Consulting Engineers, Reykjavik (Iceland).
For primary bibliographic entry see Field 2F.
W87-08829

POST-POOL RAISE SPILLWAY PROTOTYPE TEST FOR CHIEF JOSEPH DAM COLUMBIA RIVER, WASHINGTON,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
T. L. Fagerburg.
Technical Report HL-87-2, April 1987. Final Report. 62 p, 25 tab.

Descriptors: *Spillways, *Hydraulic structures, *Chief Joseph Dam, *Columbia River, *Washington, Hydraulic properties, Hydrologic models, Hydraulic head, Piezometry, Water pressure.

Prototype test data on the hydraulic performance of the standard US Army Corps of Engineers spillway crest at Chief Joseph Dam were obtained following structural modifications to the project required to raise the pool for expansion of hydropower capabilities. These data were correlated with comparable data obtained in model studies of the dam and compared with the data of earlier prototype tests prior to the pool raise. The prototype data consisted of spillway pressure profiles obtained with piezometers, pressure fluctuations indicated by pressure cells embedded in the spillway crest, and vibrations monitored by accelerometers bonded to the trunnion bridge and access gallery floor. The data were obtained at heads of 1.31 and 1.21 times the design head H sub d in one gate bay at full and partial gate openings. Good correlation was found between the model and prototype spillway data for the increased head design. The negative pressures in the prototype generally agreed with those predicted in the model. These negative pressures exceeded those obtained in earlier prototype tests primarily due to the increased pool elevation and subsequent higher heads. No significant pressure fluctuations that could cause resonance in the structure were found for any flow condition. No significant vibrations or displacements were evident from the acceleration measurements. (Author's abstract)
W87-09153

EMBANKMENT DAM INSTRUMENTATION MANUAL,
Colorado Univ. at Denver. Dept. of Civil Engineering.
C. L. Bartholomew, B. C. Murray, and D. L. Goins.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as PB87 155768. A03 in paper copy, A01 in microfiche. January 1987. 250 p, 115 fig, 8 tab, 90 ref, 4 append.

Descriptors: *Embankments, *Dams, *Manuals, *Instrumentation, Construction, Reservoirs, Monitoring, Hydraulic properties, Vibration, Seepage, Water pressure.

Using instruments to gather information on the performance of an embankment dam is vital. The safety and proper functioning of a dam must be assessed continuously - during construction, during first filling of the reservoir, and during the service life of the dam. Many types of instrumentation systems are used for embankment dams. Systems monitor water pressure, seepage, internal movement, surface movement, vibration, and other significant parameters. The various instrumentation systems used by the Bureau of Reclamation are described in this manual, which is intended for designers, engineers, instrument readers, dam operators, and dam safety personnel. The history, purpose, and current usage of each type of system is discussed. Each system is described; its advantages and disadvantages are analyzed; and its installation monitoring, and data handling procedures are outlined. (Author's abstract)
W87-09157

FOUNDATION TREATMENT USING PNEUMATICALLY APPLIED CONCRETE,
Water and Power Resources Service, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 8F.
W87-09158

COOLIDGE DAM: PHOTOGRAPHS WRITTEN HISTORICAL AND DESCRIPTIVE DATA REDUCED COPIES OF DRAWINGS,
National Park Service, San Francisco, CA. Western Region.
D. M. Introcaso.
Available from the National Technical Information Service, Springfield, Virginia, 22161. Report No. HAER No. AZ-7, 1986. 136 p, 111 fig, 132 ref.

Descriptors: *Coolidge Dam, *Gila River, *Arizona, *Water resources development, Water supply, Irrigation, Dams, Structural engineering, Hydraulic structures.

Coolidge Dam, a unique multiple dome structure is unique in that its design employs a variation on the successive arch design. Three large domes, anchored by two buttresses, stand approximately 250 feet, impounding the Gila River for twenty three miles when full. Because of the unique design, construction required the fabrication of special form work to carry the domes vertically and then flaring downstream. The dam's construction plant layout design was also innovative, using a tramway to convey aggregate to the mixing plant which used a gravity flow system to process concrete to the placing tower. Combined with a dual cableway system, the construction design made good use of available technology and provided an integrated system limiting excessive labor. Because of the several novel elements used to construct the dam, it was completed one year ahead of schedule. Today, Coolidge Dam supplies developed Gila River water to the Pima and Maricopa Indian tribes on the Gila River Indian Reservation under the San Carlos Irrigation Project, and to anglo lands under the San Carlos Irrigation and Drainage District. Both entities, under adjudicated rights, can cultivate up to 50,000 acres depending on available storage behind Coolidge. Although water delivery is administered by two independent agencies, both share an integrated water transmission and delivery system. (Lantz-PTT)
W87-09163

DESIGN OF SPILLWAY CRESTS,
MCI Consulting Engineers, Inc., Nashville, TN.
A. J. Reese, and S. T. Maynord.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 113, No. 4, p 476-490, April 1987. 12 fig, 2 tab, 19 ref, 1 append.

Descriptors: *Hydraulic design, *Spillway crests, *Flood control, *Hydraulic structures, Model studies, Slopes, Discharge coefficient, Piers, Dam stability, Hydraulics, Abutments, Cavitation, Flow, Mathematical studies, Mathematical equations, Engineering, Hydraulic engineering.

The elliptical upstream quadrant spillway design as proposed by Murphy (1973) has been tested over a wide range of conditions. It has been shown to yield reliable hydraulic characteristics and has been demonstrated to closely fit the lower nappe of a ventilated sharp-crested weir. Though prototype data are lacking, unpublished model study results of a spillway designed using this method compare well with predicted values. The advantage to using this method is that it is supported by systematic experimental data, and it is applicable to spillways of any practical height or upstream face slope. (Author's abstract)
W87-09195

LATERAL OUTFLOW OVER SIDE WEIRS,
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. of Civil Engineering.
W. H. Hager.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 113, No. 4, p 491-504, April 1987. 7 fig, 12 ref, 1 append.

Descriptors: *Hydrodynamics, *Weirs, *Lateral outflow, *Hydraulic engineering, *Flow characteristics, *Hydraulics, Froude number, Plane flow, Engineering, Hydraulic design, Hydraulic structures, Flow, Prediction, Channels, Irrigation systems, Flood protection, Sewer systems.

The lateral outflow mechanism of side weirs is investigated using a one-dimensional approach. In particular, the effects of flow depth, approaching velocity, lateral outflow direction and side weir channel shape are included, resulting in expressions for the lateral outflow angle and the lateral discharge intensity. The conventional weir formula for plane flow conditions is reproduced for vanishing channel velocity. However, for increasing local Froude number, the lateral outflow intensity decreases under otherwise fixed flow parameters. A comparison of the theoretically determined solution with observations indicates a fair agreement. The results are then applied to open channel bifurcations by considering a side-weir of zero weir height. Distinction between sub- and supercritical flow conditions is made. Again, the computed results compare well with the observations and allow a simple prediction of all pertinent flow characteristics. (Author's abstract)
W87-09196

FISH DIVERSION IN HYDROPOWER INTAKE,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 8I.
W87-09197

STREAMBANK PROTECTION BY SUBMERGED VANES,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 4D.
W87-09198

DESIGN AND USE OF PRESSURE SEWER SYSTEMS,
Thrasher Engineering, Rogers, AR.
For primary bibliographic entry see Field 5D.
W87-09309

CONCRETE DAM OF THE DENIN DNEPR HYDROELECTRIC STATION,
V. N. Durcheva, A. N. Kazachenko, and S. M. Puchkova.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 7, p 381-386, July 1986. 4 fig, 6 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 1-5, July 1986.

Descriptors: *Concrete dams, *Concrete construction, *USSR, *Dams, *Construction, Concrete, Design, Foundations.

This report describes the Construction history of the Dneprdam, which was first constructed from 1927-1932, twice destroyed in 1941 and 1943, rebuilt from 1944-1950, and expanded from 1970-1980. The theory behind the design of the original dam is discussed with special mention made of the problems of concrete cracking. The reconstruction is also described, and a summary of the present state of the dam is given. It is concluded that the reconstruction and the expansion of the dam were carried out successfully, that the static behavior of the dam is characterized by a thermal stress state of the concreted, and that in the future it will be necessary to determine the effect of gas on a change in the seepage resistance in the rock foundation and hydrostatic levels. (Ram-PTT)
W87-09352

ARCH DAM OF THE KHUDONI HYDROELECTRIC STATION,
P. A. Dzhakeli, V. D. Kobakhidze, and G. I. Koridze.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 7, p 386-393, July 1986. 5 fig, 3 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 5-11, July 1986.

Descriptors: *Arch dams, *Khudoni station, *Dam construction, *Hydroelectric power stations, Concentration methods, Dams, Inguri River, USSR.

The Khudoni hydroelectric station is located in the western part of the Georgian SSR on the Inguri River at a site 32 kilometers above the site of the Inguri dam. The Khudoni station includes the following main structures: a concrete arch dam 200.5 m high, a free flow diversion tunnel located on the left bank of the canyon with a length of 438 m and cross section of 9 x 10 m with a design discharge of 1030 cubic meters per second, three deep lake intakes with sill elevations of 110 and 128 m with an emergency guard gate chamber located on the right bank of the river near the dam, 175 m long inclined penstock, underground power house with three units N=700,000 kW, normal annual production of 1660 million kWh, and three tailrace pressure tunnels with surge tanks, each 90 m long. The report describes the engineering geologic and semitectonic conditions of the site, and the design selection, the structural elements, the reinforcement, the stress-strain state, the underground contouring and the outlet workjs of the dam. (Ram-PTT)
W87-09353

ASSIGNMENT OF STRENGTH REQUIRMENTS OF CONCRETE FOR LARGE DAMS,
For primary bibliographic entry see Field 8F.
W87-09354

CONSIDERTION OF THE STRESS-STRAIN STATE IN CALCULATIONS OF SLOPE STABILITY OF EARTH DAMS,
For primary bibliographic entry see Field 8D.
W87-09356

MODEL OF STABILITY OF REVETMENTS OF EARTH SPILLWAY SLOPES,
For primary bibliographic entry see Field 8D.
W87-09357

DETERMINATION OF THE ICE LOAD ON ELEMENTS OF MARINE HYDRAULIC STRUCTURES,
A. L. Golldin, and M. G. Gladkov.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 7, p 417-420, July 1986. 1 fig, 3 tab, 9 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 27-29, July 1986.

Descriptors: *Sea ice, *Ice load, *Marine structures.

The existing methods of determining ice loads on hydraulic structures were developed on the basis of long-term experiments on the effect of ice on river structures during the spring ice run. For marine structures the maximum ice loads occur during slow horizontal movements of the ice flow with speed of 0.1 meters per second or less. Therefore, the techniques used on rivers are not used at sea. The design of safe, economical marine structures requires a consideration of the maximum ice load. At present there are no sufficiently substantial methods of calculating the maximum ice loads for sea conditions. The purpose of this work was to investigate the limit state of sea ice interacting with the vertical elements of hydraulic structures and to develop a simple, reliable method of determining the maximum ice load on marine structures. (Ram-PTT)
W87-09359

DETERMINATION OF MAXIMUM DESIGN DISCHARGES,
For primary bibliographic entry see Field 2E.
W87-09362

ON-SITE OBSERVATIONS OF THE STATE OF STRUCTURES AT THE KANEV LOCK,
For primary bibliographic entry see Field 7A.
W87-09363

FUTURE TRENDS IN HYDROPOWER DEVELOPMENT IN CHINA,
Dept. of Foreign Affairs, Ministry of Water Resources and Electric Power, Beijing, China.
T. Aixing.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 5, p 14-16, May 1987. 1 fig, 3 tab.

Descriptors: *Hydropower development, *Hydroelectric power, *China, *Water resources development, Dams, Construction, Yangtze River, Yellow River, Hougshui River.

Only about 7 per cent of China's vast hydro potential has so far been developed. Although more than 80,000 plants have been built, most of these have been small-scale projects. In the seventh five-year plan (1986-90) hydropower development is being accelerated, and a total installed capacity of 8000 MW is to be added in this period. Major schemes are planned on the Yangtze, Yellow and Hongshui rivers. (Author's abstract)
W87-09407

CONCRETE TEMPERATURE CONTROL DURING DAM CONSTRUCTION,
Binnie and Partners, Consulting Engineers, 25 Newgate Street, Chester, UK.
For primary bibliographic entry see Field 8F.
W87-09408

MONITORING PROGRAMME FOR EMBANKMENT DAMS,
Lahmeyer International G.m.b.H., Frankfurt am Main (Germany, F.R.).
L. D. Schewe.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 5, p 23-26, May 1987. 12 tab.

Descriptors: *Embankment dams, *Monitoring, *Reservoirs, Construction, Dams, Measuring instruments, Design standards, Operations.

The article summarizes the experiences of monitoring the behavior of embankment dams mainly during the critical period of the initial reservoir filling. It presents recommendations for the frequency of regular measurements, and relevant counter-measures for the occurrence of anomalies in the dam's behavior. (Author's abstract)
W87-09409

ROMAN DAMS IN SOUTHERN PORTUGAL,
Technical Univ. of Lisbon (Portugal).
For primary bibliographic entry see Field 6E.
W87-09411

SRI LANKA'S RANDENIGALA PROJECT,
Salzgitter Consult GmbH, Postfach 41 11 69, 3320 Salzgitter 41, Federal Republic of Germany.
U. Drewes.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 5, p 45-50, May 1987. 6 fig, 2 tab, 7 ref.

Descriptors: *Hydropower development, *Randenigala Project, *Sri Lanka, *Rockfill dams, *Dams, Construction, Turbines, Mahaweli River, Irrigation.

Randenigala is one of five major schemes which together form the Accelerated Mahaweli Program. After a construction period of four years, the 102 m-high Randenigala rockfill dam and its appurtenant structures were completed in August 1986, on schedule. With the final commissioning of the turbines at the end of 1986, the Randenigala project now fulfills all of its multipurpose tasks. (Author's abstract)
W87-09412

OVERTOPPING RISK FOR AN EXISTING DAM,
Illinois Univ. at Urbana-Champaign.
S. T. Cheng, B. C. Yen, and W. H. Tang.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-168146, A10 in paper copy, A01 in microfiche. December 1982. 197 p, 56 fig, 24 tab, 94 ref, 3 append.

Descriptors: *Hydraulic structures, *Dams, *Water level fluctuations, *Reservoirs, *Probability models, *Risks, Mathematical models, Model studies, Floods, Earth dams, Wind.

A probability-based methodology for evaluating the overtopping risk of dams is formulated. A load combination model is established to account for the combined effects resulting from concurrence of flood and wind. A procedure for evaluating the risk of overtopping induced by flood and wind is presented. Four risk computation techniques are compared: (1) direct integration method; (2) Monte Carlo simulation method; (3) mean-value first-order second-moment method, and (4) advanced first-order second-moment method. The advanced first-order second-moment method is shown to be the preferred method for risk evaluation of dams. A medium-sized earth dam in northern Illinois is used as an example to demonstrate how to evaluate the risk of overtopping over a given period of time using the proposed risk model and procedure. Overtopping risk evaluated by using the normal pool level of the reservoir together with an inflow flood generated by 24-hour rainfall is found to be conservative. (Author's abstract)
W87-09461

DREDGED MATERIAL CONTAINMENT IN LONG ISLAND SOUND (WITH SPECIAL EMPHASIS ON EASTERN NEW YORK WATERS),
Tetra Tech, Inc., Melville, NY.
J. Pagenkopf.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-122969, A07 in paper copy, A01 in microfiche. Addendum to Interim Report to U.S. Army Corps of Engineers, New England Div., March 1981. 128 p, 13 fig, 21 tab, 1 ref, 2 append.

Descriptors: *Dredging, *New York, *Connecticut, *Ocean dumping, *Water pollution control, Water pollution prevention, Water pollution sources, Spoil banks, Wastes, Waste disposal, Waste management.

One hundred twenty-one sites for possible permanent dredged material containment facilities along the New York-Connecticut shoreline were examined. The primary considerations for site selection were presented and discussed. Considerations include: engineering aspects such as containment capacity, exposure access; optimization of economic benefits such as minimum construction costs and capitol investments, minimum operations and maintenance costs, maximum re-use potential; environmental protection; and protection of overall public interest, including public health and welfare, social acceptability, and legal and regulatory aspects. (Halterman-PTT)
W87-09474

PROTECTION OF THE KARSTIC SPRINGS SYSTEM IN GOLUBINKA AGAINST CONTAMINATION BY THE SEA WATER (LA PROTECTION DU SYSTEME DES SOURCES KARSTIQUES DE GOLUBINKA CONTRE LA CONTAMINATION PAR LA MER),
Elektroprojekt, Zagreb (Yugoslavia).
For primary bibliographic entry see Field 4B.
W87-09582

GROUNDWATER CONTROL IN OPENCAST MINING OF A LIGNITE DEPOSIT IN SOUTHERN GREECE,
Public Power Corporation Administration of Mines, Athens (Greece).
For primary bibliographic entry see Field 4B.
W87-09583

INFLUENCE OF UNDERGROUND CONSTRUCTIONS IN CRYSTALLINE ROCK ON GROUNDWATER CONDITIONS AND THE USE OF ARTIFICIAL RECHARGE TO RESTORE A LOWERED PIEZOMETRIC SURFACE,

Chalmers Univ. of Tech., Goteborg (Sweden). Dept. of Water Supply and Sewerage.
For primary bibliographic entry see Field 4B.
W87-09589

HYDROGEOLOGICAL ASPECTS OF GROUND WATER INFLOW IN THE JUKTAN TUNNELS, SWEDEN,
Centrala Driftledningen, Vaellingby (Sweden).
For primary bibliographic entry see Field 2F.
W87-09591

SYSTEM OF UNDERGROUND WATER IN A KARSTIC COUNTRY AND THE TUNNELS EXCAVATED FOR WATER TRANSPORT TO ATHENS (LE REGIME DES EAUX SOUTERRAINES DANS UN PAYS KARSTIQUE ET LES GALERIES DE LA GRANDE ADDUCTION D'EAU D'ATHENES),
Univ. de Thrace, Xanthi (Greece). Lab. de Geologie d'Ingenieur.
For primary bibliographic entry see Field 2F.
W87-09595

PROBLEMS OF WATER INRUSH INTO GREEK UNDERGROUND MINES WITH SPECIAL EMPHASIS TO SEA WATER INRUSH THROUGH KARSTIC LIMESTONES OR IMPERMEABLE FORMATIONS,
Athens Univ. (Greece).
For primary bibliographic entry see Field 2F.
W87-09596

SOME HYDROGEOLOGICAL SOLUTIONS TO THE EXPLOITATION OF UNDERGROUND LIGNITE MINES (QUELQUES SOLUTIONS HYDROGEOLOGIQUES DANS LA CONSTRUCTION DES MINES DE LIGNITE SOUTERRAINES),
For primary bibliographic entry see Field 4B.
W87-09597

8B. Hydraulics

OPEN-CHANNEL HYDRAULICS,
Nevada Univ. System, Las Vegas. Desert Research Inst.
R. H. French.
McGraw-Hill Book Co., New York, NY. 1985. 706 p.

Descriptors: *Open-channel flow, *Open channels, *Hydraulic properties, Flow characteristics, Channel flow, Flow measurement, Diffusion, Gages, Mathematical studies, Streamflow, Gaging, Stream gages, Model studies.

This book is designed primarily as a reference for the practicing engineer; however, a significant number of examples are used, and it can serve adequately as a text in either an undergraduate or graduate course in civil or agricultural engineering. The book approaches open-channel hydraulics from the viewpoint of presenting basic principles and their application. There are 14 chapters. In Chapter 1, basic definitions and the equations which govern flow in open channels are introduced. In Chapters 2 and 3, the laws of conservation of energy and momentum are introduced, and applications of these basic laws to both rectangular and nonrectangular channels are discussed. In Chapters 4 and 5, uniform flow and its computation are discussed. Chapter 6, gradually and spatially varied flow is considered. In Chapter 7, various methods of designing channels are presented (lined channels, stable, unlined, earthen channels, and grass-lined channels). In Chapter 8, methods of flow measurement are considered. Techniques included in this discussion are devices and procedures for stream gaging, weirs, flumes, and culverts. In Chapter 9 rapidly varied flow in nonprismatic channels is discussed. Chapter 10 discusses transport processes known as turbulent diffusion and dispersion. In Chapter 11 the topic of turbulent, buoyant surface jets in open-channel flow is discussed. In Chapters 12 and 13 gradually and rapidly varied unsteady flows are considered. Finally, in Chapter 14, the design, construction, and use of physical models in the study of open-channel hydraulics are discussed. Among the types of models considered are geometrically distorted and undistorted; fixed and movable bed; and ice. (Lantz-PTT)
W87-08688

REVERSE PATHLINE CALCULATION OF TIME-RELATED CAPTURE ZONES IN NONUNIFORM FLOW,
Illinois State Water Survey, Champaign. Ground-Water Section.
For primary bibliographic entry see Field 2F.
W87-08753

RIVER FLOW WITH EXCESSIVE SUSPENDED SEDIMENT LOAD: AN EVALUATION OF TURBULENT FLOW CHARACTERISTICS,
Lulea Univ. of Technology (Sweden).
For primary bibliographic entry see Field 2E.
W87-08826

LATERAL MIXING IN CHANNELS DUE TO SECONDARY CURRENTS,
Uppsala Univ. (Sweden). Div. of Hydrology.
For primary bibliographic entry see Field 2E.
W87-08827

HYDRODYNAMICS AND STRUCTURE: INTERACTIVE EFFECTS ON MEIOFAUNA DISPERSAL,
Wabash Coll., Crawfordsville, IN. Dept. of Biology.
For primary bibliographic entry see Field 2L.
W87-08838

STRUCTURE AND DYNAMICS OF INTERNAL WAVES IN BALDEGGERSEE,
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
For primary bibliographic entry see Field 2H.
W87-08864

DYNAMICS OF BOTTOM CURRENTS IN A SMALL LAKE,
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'hydraulique.
For primary bibliographic entry see Field 2H.
W87-08865

SURFACE MANIFESTATIONS OF INTERNAL OSCILLATIONS IN A HIGHLY SALINE LAKE (THE DEAD SEA),
Weizmann Inst. of Science, Rehovot (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 2H.
W87-08866

POST-POOL RAISE SPILLWAY PROTOTYPE TEST FOR CHIEF JOSEPH DAM COLUMBIA RIVER, WASHINGTON,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W87-09153

LATERAL OUTFLOW OVER SIDE WEIRS,
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W87-09196

STREAMBANK PROTECTION BY SUBMERGED VANES,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 4D.
W87-09198

BASIC HYDRAULICS,
Royal Military Coll. of Science, Shrivenham (England). Dept. of Civil Engineering.
P. D. Smith.
Butterworth Scientific, London, England. 1982. 156 p.

Descriptors: *Hydraulic engineering, *Computers, *Computer programs, *Groundwater movement, *Open-channel flow, Flow profiles, Hydraulic machinery, Civil engineering, Seepage.

Computing is seen to a great help to engineering because a clear exposition (and consequently a good understanding) of the engineering equations and procedures is required in order to write a successful computer program. This book uses the programming language called BASIC, and aconym derived from 'Beginners All-purpose Symbolic Instruction Code'. With the development of microcomputers which have built-in BASIC, this language has largely usurped FORTRAN (and its variants) as the msot important computer language for general use by engineers. When students write computer pgrograms, the use of BASIC is seen to have the advantage over other languages in that it enables programs to be developed (i.e. run, modified when errors are found and then re-run until successful operation has been achieved) more rapidly than with other systems. With the exception of the first, which presents a summary of the technique of computing in BASIC together with comments and listing of the main commands and statements, each chapter consists of a shrot text which contains a summary of relevant theory. This is in the form of short 'essays' which introduce the fundamental concepts and the appropriate governing equations. There follows a series of worked examples consisting primarily of an introduction in which teh general topic or specific problem to be considered is presented. A program capable of solving the problem, etc. is then given, together with examples of the output, sometimes for several different sets of conditions. Finally, in a section headed Program Notes the way the program is constructed and operates is comprehensively, yet concisely, explained and the engineering lessons to be learnt from the program output are indicated. Each chapter concludes with a set of problems for the student to attempt. The chapter topics are those which form the basis of a fundamental appreciation of civil engineering hydraulics commencing with a chapter that introduces the elements of fluid mechanics. Chapter 3 deals with flow in bounded systems - pipies and conduits - and includes not only the theory of steady flow, but also an introduction to the theory of pressure transients in pipelines. In Chapter 4, open channel flow is introduced and includes uniform, rapidly and gradually varying flow, and unsteady channel flows. Chapter 5 discusses the theory of hydraulic machines laying particular emphasis on those machines that are of prime concern in civil engieering. The final chapter is concerned with groundwater and seepage flow, introducing the concept of potential functions to desribe the flow associated with many different physical situations. (Lantz-PTT)
W87-09304

PROGRAMMED CLOSING OF GATES UPON LOSS OF DRIVE BY A PUMP UNIT,
For primary bibliographic entry see Field 8C.
W87-09355

INTERNAL HYDRAULICS OF DIFFUSERS WITH UNIFORM LATERAL MOMENTUM DISTRIBUTION,
Concordia Univ., 1455 De Maisonneuve, Montreal, Quebec, Canada H3G 1M8.
A. S. Ramamurthy, and M. G. Satish.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 3, p 449-463, June 1987. 9 fig, 1 tab, 12 ref.

Descriptors: *Wastewater disposal, *Outfall, *Hydrodynamics, *Hydraulics, *Diffusers, *Pipes, *Static mixers, Effluents, Model studies, Distribution.

This study deals with the internal hydraulics of a multiport diffuser that ensures uniform momentum distribution along the span of main pipe. Multiport diffuser systems consisting of lateral outlets are

generally found suitable for mixing chemicals and for the disposal of large quantities of industrial effluents. For effluents whose mixing is dominated by the source momentum flux, it is important to maintain a uniform lateral momentum distribution along the length of the main pipe. Experiments to verify the proposed model were also conducted. Results in the form of design charts for specific cases of hydraulically smooth as well as rough pipes are presented. (Author's abstract)
W87-09366

TURBULENCE STATISTICS IN FULLY DEVELOPED CHANNEL FLOW AT LOW REYNOLDS NUMBER,
NASA Ames Research Center, Moffett Field, CA 94035, USA.
J. Kim, P. Moin, and R. Moser.
Journal of Fluid Mechanics JFLSA7, Vol. 177, p 133-166, April 1987. 25 fig, 2 tab, 50 ref.

Descriptors: *Numerical analysis, *Hydrodynamics, *Channel flow, *Turbulent flow, *Turbulence, Simulation, Statistics, Reynolds number, Flow.

A direct numerical simulation of a turbulent channel flow is performed. The unsteady Navier-Stokes equations are solved numerically at a Reynolds number of 3300, based on the mean centerline velocity and channel half-width, with about 4000000 grid points (192 x 129 x 160 in x, y, z). All essential turbulence scales are resolved on the computational grid and no subgrid model is used. A large number of turbulence statistics are computed and compared with the existing experimental data at comparable Reynolds numbers. Agreements as well as discrepancies are discussed in detail. Particular attention is given to the behavior of turbulence correlations near the wall. In addition, a number of statistical correlations which are complementary to the existing experimental data are reported for the first time. (Author's abstract)
W87-09383

CONFORMAL-MAPPING TECHNIQUE FOR TOPOGRAPHIC-WAVE PROBLEMS: SEMI-INFINITE CHANNELS AND ELONGATED BASINS,
JISAO, Univ. of Washington, Seattle, WA 98195, USA.
For primary bibliographic entry see Field 7C.
W87-09384

SCANNING CURRENTS IN STOKES FLOW AND THE EFFICIENT FEEDING OF SMALL ORGANISMS,
New York Univ., NY. Courant Inst. of Mathematical Sciences.
For primary bibliographic entry see Field 2H.
W87-09385

HYDRAULIC MODEL STUDY OF PORT HURON ICE CONTROL STRUCTURE,
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 2C.
W87-09473

EROSION CONTROL OF SCOUR DURING CONSTRUCTION; REPORT 6: FINITE - A NUMERICAL MODEL FOR COMBINED REFRACTION AND DIFFRACTION OF WAVES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
J. R. Houston, and L. W. Chou.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report HL-80-3, September 1984. 98 p, 28 fig, 23 ref, append.

Descriptors: *Hydraulics, *Erosion control, *Model studies, *Waves, Mathematical models, FINITE model, Finite element method, Numerical analysis, Shallow water, Hydraulic structures, Scour, Sediment transport, Coastal engineering, Water currents.

A hybrid finite element numerical model (FINITE) is presented that solves a linear mild-slope equation for short-wave propagation. The efficient formulation of the model permits the solution of large problems with relatively small time and memory storage requirements. Although the model solves an equation that is strictly valid only for mild bathymetric variations, the model can provide reasonable answers for problems where there are rapid depth variations (at much lower cost than required by three-dimensional models that are appropriate for problems involving rapid depth variations). The model does not provide a mechanism for energy dissipation, and thus energy loss through wave breaking is simulated by permitting waves to propagate out of the computational region. The program documentation, user guide, and sample problem output are provided. (Author's abstract)
W87-09482

LOW FRESHWATER INFLOW STUDY: CHESAPEAKE BAY HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2L.
W87-09484

EFFECTS OF STORAGE REALLOCATION ON THERMAL CHARACTERISTICS OF COWANESQUE LAKE, PENNSYLVANIA: NUMERICAL MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2H.
W87-09485

KAHULUI BREAKWATER STABILITY STUDY, KAHULUI, MAUI, HAWAII: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
D. G. Markle.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report HL-82-14, July 1982. Final Report. 154 p, 3 fig, 4 tab, 100 photos, 22 plates, append.

Descriptors: *Stability analysis, *Breakwaters, *Hydraulic models, *Model studies, *Design criteria, *Sea walls, *Mathematical models, *Mathematical studies, Models, Hydraulic engineering, Harbors, Project planning.

A hydraulic model was used to test the stability against wave attack of proposed rehabilitation plans for two areas on the harbor sides of the east and west breakwaters at Kahului Harbor. Proposed rehabilitation designs for two observation stations were evaluated for stability against wave attack. All plans were tested for the worst breaking wave conditions for the selected wave periods, water depths, and bathymetry seaward of the test sections, and were modified until stable design sections were found. Six plans (3 colors and 3 tribar) were found acceptable. With the addition of a concrete rib cap on the crown of the west breakwater, 11-ton and 5-ton tribars were found to be stable on the sea- and harbor-side slopes, respectively. For the east breakwater 9-ton tribars showed very good stability. A concrete rib cap was added to stabilize the crown and upper seaside slope of the east breakwater and 9-ton tribars provided stable protection for the harbor-side slope. The stabilities of all acceptable plans were dependent upon trenching and/or special placements of the toe armor units. Harbor-side armor unit protection should not extend above the breakwater crown elevation any more than absolutely necessary. (Geiger-PTT)
W87-09488

DEVELOPMENTS IN LARM2: A LONGITUDINAL-VERTICAL, TIME-VARYING HYDRODYNAMIC RESERVOIR MODEL,
Edinger (J.E.) Associates, Inc., Wayne, PA.
J. E. Edinger, and E. M. Buchak.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA 124442, A04 in paper copy, A01 in microfiche. Technical Report E-83-1, January 1983. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 66p, 7 fig, 6 tab, 7 ref, append.

Descriptors: *Hydrodynamics, *Lakes, *Reservoirs, *Water quality, *Streamflow forecasting, *Mathematical models, Water temperature, Computer programs, LARM model, LARM2 model, LAEM model, Model studies, Estuaries, Tides, Center Hill Lake, Tennessee, Flow characteristics, Potomac Estuary, Saline water, Temperature.

The LARM model (Laterally Averaged Reservoir Hydrodynamic Model) was enhanced by the incorporation of a water quality transport module (WQTM) and the capability to add or delete upstream longitudinal segments during flooding or drawdown. The modified model was designated LARM2. WQTM is a general-purpose transport algorithm for which the user must specify the water quality constituents and the constituent internal sources and sinks with the associated reaction rates. LARM2 was used to simulate temperatures at Center Hill Lake, Tennessee. Observed and predicted temperatures of water discharged at different heights were in good agreement. Hydrodynamic boundary conditions were simulated for the Potomac Estuary, using the estuarine version of the model, LAEM (Laterally Averaged Estuary Model). (Cassar-PTT)
W87-09489

DETAILED PROJECT REPORT AND ENVIRONMENTAL ASSESSMENT: SECTION 111, SHORES EAST OF DIKED DISPOSAL AREA, LORAIN HARBOR, OHIO.
Corps of Engineers, Buffalo, NY. Buffalo District.
For primary bibliographic entry see Field 6G.
W87-09491

8C. Hydraulic Machinery

PROGRAMMED CLOSING OF GATES UPON LOSS OF DRIVE BY A PUMP UNIT,
V. Y. Karelin, N. N. Arshenevskii, R. A. Novoderezhkin, B. B. Pospelov, and V. N. Zakharov.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 7, p 397-401, July 1986. 4 fig, 1 tab, 3 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 13-16, July 1986.

Descriptors: *Pumps, *Gates, *Mathematical analysis, *Automation, *Pressure, *Hydrodynamics.

Dynamic loads in elements of hydromechanical equipment and structural elements of pumping stations reach maximum values upon loss of drive by the pump unit. In pumping stations equipped with check valves, owing to the delay in the initial and high speed in the final phase of closing the valve, a water hammer occurs in the pressure conduits, which is dangerous. At stations not equipped with check valves, owing to the insufficient speed of closing of the gate valve or butterfly valve, discharge of water is observed from the pressure conduit, causing reverse rotation of the rotor and increased dynamic loads on elements of the units. In order to minimize the increased loads and the water hammer the movement of the shutoff should occur rapidly in the initial phase and slowly in the final phase. A method of determining a shutoff closing law is determined which provides a minimum increase of pressure and dynamic loads on the unit. (Ram-PTT)
W87-09355

MEASURES TO REDUCE THE LEVEL OF VIBRATIONS OF TURBINE-GENERATOR UNITS,
V. I. Kolesnikov, A. S. Dolgopolov, and V. E. Engel.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 7, p 451-455, July 1986. 4 fig, Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 52-55,

July 1986.

Descriptors: *Generators, *Turbines, *Electrical equipment, *Vibration, *Bearings.

When increased vibration of a turbine generator is a consequence of different forces which have different origins, a need arises to conduct special tests and measurements for determining the degree of effect of each force on components of the unit and developing technical measures to reduce the effect of these forces on the vibrational state of the unit. This report carried out a study of the SVCh 790/106-52 generator (rated capacity 25MW) with one generator bearing located in the same oil bath as the thrust bearing through which the load was transmitted to the turbin cover. The work on centering the unit with consideration of the natural sagging of the turbine block made it possible to reduce the vibration of components by more than 50 percent. (Ram-PTT)
W87-09365

STATUS OF DOE SMALL HYDROPOWER RESEARCH AND DEVELOPMENT PROJECTS.
Idaho National Engineering Lab., Idaho Falls.
Available from the National Technical Information Service, Springfield, VA 22161, as DE83 001353, A03 in paper copy, A01 in microfiche. EGG-HYD-6024, September 1982. Edited by E. H. Magleby, B. N. Rhinehart and J. R. Chappell. 26 p, 23 fig, 2 tab. Contract No. DE-AC07-76ID01570.

Descriptors: *Hydraulic machinery, *Turbines, *Hydroelectric power, *Electric power, Dams, Electrical equipment, Fish passages, Environmental effects.

The status and results of Department of Energy small hydropower research and development projects is summarized. Projects include use of a scroll motor as a turbine, cross-flow turbine, diffuser optimization with water jets around the draft tube entrance, free stream turbines, Schneider engine, modular hydro-dam, variable speed synchronous generator, hydraulic air compressor, marine thruster turbine, low-cost fish passages, pumps as turbines, modular float-in powerhouses, powerhouse gates, and turbine index tests. The report also presents a bibliography of completed reports and ordering information. (Cassar-PTT)
W87-09478

FIXED-CONE VALVE PROTOTYPE TESTS, FINAL SERIES, NEW MELONES DAM, CALIFORNIA,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
T. L. Fagerburg.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report HL-84-7, August 1984. 54 p, 6 fig, 7 tab, 14 plates, 9 ref, append.

Descriptors: *Hydraulic equipment, *Hydraulic valves, *Design criteria, *Models, *Hydraulic machinery, *Performance evaluation, *Prototype tests, *Prototypes, Dam design, Model testing.

Prototype tests of the New Melones Dam, California, were conducted to determine the performance of the fixed-cone valve and hood at different pool elevations. Initially, the 78-in-diameter Flood Control and Irrigation valve was tested at a pool elevation of 804.0 ft in conjunction with tests on the small 66-in-diameter low level valves. Final tests were conducted at a pool elevation near 1014.0 ft to determine the dynamic response of the 78-in-diameter fixed cone valve and 18-ft-diameter hood. Fatigue-type failure under prolonged operation was examined and results were compared with those of the earlier tests and model tests. Results showed that the discharge coefficients of the fixed-cone valve are in close agreement with those determined from the model, base test and Hydraulic Design Criteria curve. Flow conditions in the prototype valve and hood agreed with model and basic tests, however, there was a general increase in valve and hood pressures over those observed in the basic tests. The dominant frequencies of valve vibrations due to acceleration were generally less than those observed in the basic test data while the dominant frequency of the hood vibrations was generally slightly increased over that for the basic tests. The dominant frequency of axial strain fluctuation was 7.8 Hz, a value which compares favorably with results presented in the basic report. (Geiger-PTT)
W87-09483

PUMPING PERFORMANCE AND TURBIDITY GENERATION OF MODEL 600/100 PNEUMA PUMP: MAIN TEXT AND APPENDIXES A AND B,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
T. W. Richardson, J. E. Hite, R. A. Shafer, and J. D. Ethridge.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA 117854, A09 in paper copy, A01 in microfiche. Technical Report HL-82-8, April 1982. Final Report. 660 p, 43 fig, 3 tab, 1 plate, 3 append.

Descriptors: *Hydraulic equipment, *Hydraulic machinery, *Pumps, *Pump testing, *Performance evaluation, *Dredging, *On-site tests, Turbidity, Evaluation, Bottom sediments.

A patented, air-operated solids handling device called PNEUMA pump was evaluated for performance during full-scale dredging operations in a river channel, lock entrance, tidal inlet, and dock area in both sand and fine-grained sediment. The pump body incorporates three large cylindrical pressure vessels, each having a material intake on the bottom and an air port and discharge outlet on top. Check valves allow flow in only one direction on the intake and discharge outlets and different attachments may be fitted on the intakes for removal of varying types of bottom material. Results were evaluated in terms of pumping performance and turbidity generated in fine-grained sediment. The PNEUMA pump could dredge in situ densities in fine-grained sediment but did not perform well in sand. Differences were encountered in maintaining high discharge densities and the power efficiencies of the pump were low. No significant turbidity was recorded when dredging fine grained sediment. (Geiger-PTT)
W87-09487

8D. Soil Mechanics

2-D ELASTOPLASTIC SEISMIC SHEAR RESPONSE OF EARTH DAMS: THEORY,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W87-08607

2-D ELASTOPLASTIC SEISMIC SHEAR RESPONSE OF EARTH DAMS: APPLICATIONS,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W87-08608

PREDICTING SETTLEMENT AT A DAMSITE ON A TUNNEL VALLEY DEPOSIT IN ALBERTA,
Alberta Environment, Edmonton.
For primary bibliographic entry see Field 8A.
W87-08795

ALTERNATIVE PROCEDURE FOR DETERMINING THE SHRINKAGE LIMIT OF SOIL,
Water and Power Resources Service, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 2G.
W87-09159

BASIC SOIL MECHANICS,
Oxford Univ. (England). Dept. of Engineering Science.
G. W. E. Milligan, and G. T. Houlsby.
Butterworths, London, England. 1984. 132 p.

Descriptors: *Soil mechanics, *Computers, *Computer programs, Soil properties, Soil pressure, Soil stability, Erosion, Soil engineering.

This book aims to help students to become proficient at BASIC programming by using it in an important engineering subject. The large number of short programs contained in this book should convince the reader of the ease and value of computing. Chapter 1 is an introduction to BASIC. Chapter 2 introduces soil mechanics and the nature of soil as an engineering material. Chapters 3 to 7 cover the topics normally included in elementary texts on soil mechanics: identification, classification and testing of soils; earth pressures; stability of slopes; and foundations. Each chapter contains a summary of relevant theory, worked examples of computer programs, and a set of problems. The theory content may be useful as an introduction to, or revision synopsis of, the subject but is not comprehensive. The examples are posed as questions, solutions to which are given as the listing of a possible program with an example of its output and some 'program notes'. These notes explain the structure of the program and how it uses theory. The problems involve modifying or extending the example programs and writing completely new ones. The reader can learn about both BASIC programming and soil mechanics by studying the examples and attemptiong the problems. (Lantz-PTT)
W87-09307

CONSIDERTION OF THE STRESS-STRAIN STATE IN CALCULATIONS OF SLOPE STABILITY OF EARTH DAMS,
V. N. Lombardo, M. E. Groshev, and D. N. Olimpiev.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 7, p 401-404, July 1986. 6 fig, 1 tab, 3 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 16-18, July 1986.

Descriptors: *Slope stability, *Earth dams, *Stability analysis, *Dams, *Stress-strain analysis.

Stability calculations are decisive when selecting the steepness of slopes of earth dams and consequently, to a considerably extent determine their cost effectiveness. An investigation into the magnitude of the errors incurred by using the All Union Scientific Research Institute of Hydraulic Engineering - Terzaghi circular arc method and the possibilities of refining it are reported. It is concluded that the stability of earth structures can be estimated directly from solving the appropriate boundary value problem with modeling of the actual relations between stresses and strains, and that even in the simpliest cases the proposed method permits refining the surface of sliding and the value of the stability factor obtained by elementary methods. It is also concluded that the Terzaghi method provides reasonable accuracy. (Ram-PTT)
W87-09356

MODEL OF STABILITY OF REVETMENTS OF EARTH SPILLWAY SLOPES,
G. D. Guskov, and Y. P. Pravdivets.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 7, p 405-411, July 1986. 3 fig, 12 ref. Translated from Gidrotekhnicheskoe Stroitel'stov, No. 7, p 19-23, July 1986.

Descriptors: *Revetments, *Model studies, *Spillways, *Slope stability, *Mathematical analysis. Dams, Riprap.

The provision of stability of revetments of earth spillway slopes used for releasing water is one of the most important problems of hydrotechnical construction. Riprap, insitu reinforced concrete, and precast reinforced concrete elements of various configurations are used as protective revetments of earth spillway surfaces. On the basis of solving the differential equation motion a mathematical model of the stability of revetment elements of earth slopes used for discharging water was developed. The model makes it possible with a high reliability to evaluate the stability of elements of various configuration under the dynamic effect

of the discharge flow. Of the examined types of revetment, riprap was the least stable in the flow. The stability of the protective revetment of earth spillway slopes noticeably increases on changing to two dimensional (three dimensional) elements. The most stable are wedge shaped elements with drain holes. Their stability compared with two dimensional (three dimensional) element increases due to the hydrodynamic surcharge, decrease of seepage load, and increase of frictional forces owing to the specific configuration of the elements and placement. The value of the critical movement as the revetment stability criterion. (Ram-PTT)
W87-09357

SEEPAGE REGIME IN THE FOUNDATION OF THE KANEV HYDROELECTRIC STATION,
S. I. Karlin.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 7, p 444-450, July 1986. 4 fig, 1 tab, 6 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 47-52, July 1986.

Descriptors: *Seepage, *Foundations, *Hydroelectric stations, *USSR.

The Kanev hydroelectric station was constructed from 1963 to 1976. Operation of the structure began in 1972. Filling of the reservoir to the normal pool level occurred gradually from the fall of 1972 to the fall of 1976. Observations of the seepage regime were carried out by means of imbedded piezometers. It was concluded that the water tight and drainage elements of the concrete structures, according to on site observations, are working well, and that the hydrostatic levels vary almost linearly with variations of the lower pool level. (Ram-PTT)
W87-09364

8E. Rock Mechanics and Geology

DETECTION OF DEFECTS IN A GROUT CURTAIN BY GEOPHYSICAL METHODS,
V. I. Koptev, and Y. M. Gorshkov.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 7, p 411-416, July 1986. 4 fig, 1 tab, 11 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 23-27, July 1986.

Descriptors: *Grouting, *Seepage, *Dams, Foundation failure.

The majority of failures of concrete dams are related to defects of the foundation, usually caused by an increase of permeability. Elimination of these failures usually lasts several years and requires considerable investment. Grouting reduces the permeability of the foundation, thus reducing the risk of foundation failure under certain conditions. However, a check of the grouting works is one of the most difficult stages of such measures. A physical substantiation of a method of direct layerwise inspection of a grout curtain is given and the results of testing are described. The essence of the method is to evaluate the change in hydraulic communication between wells as a result of grouting works. The proposed method of detecting local defects in a cutoff curtain has a large radius of investigation and allows testing a 30 m long section of the curtain during one experiment. Each experiment takes about 4 hours. The area of use is limited to evaluation of the grout curtain below water table. The proposed method is intended for use together with other existing methods of investigation. (Ram-PTT)
W87-09358

8F. Concrete

DEVELOPMENT PROGRAMS IN THE UNITED STATES OF AMERICA FOR THE APPLICATION OF CEMENT-BASED GROUTS IN RADIOACTIVE WASTE MANAGEMENT,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5E.
W87-09113

FOUNDATION TREATMENT USING PNEUMATICALLY APPLIED CONCRETE,
Water and Power Resources Service, Denver, CO. Engineering and Research Center.
F. R. Schall, and T. H. Bruce.
Bureau of Reclamation Report No. GR-86-15, December 1986. 18 p, 14 fig, 1 tab, 3 ref.

Descriptors: *Concrete, *Foundation treatment, *Sugar Pine Dam, *California, *Auburn, *Concrete technology, Dams, Materials engineering, Concrete mixes.

The use of dental concrete as a foundation treatment is not new. This report discusses the various ways it can be applied on the rock foundation of a dam embankment and describes the specific methods used by the Bureau of Reclamation on the rock foundation of Sugar Pine Dam. Sugar Pine Dam, a part of the Auburn-Folsom Project, is located in Shirttail Canyon, 40 km (25 mi) northeast of Auburn, California. The dam is a central core rockfill embankment 56 m (184 ft) high with a crest length of 180 m (590 ft) at elevation 1112.5 m (2649 ft). An ogee section spillway located on the left abutment is designed for the future installation of a 7.94-m (26-ft) radial gate. No facilities for power generation were constructed. Dental concrete, applied pneumatically, is a fast and efficient way of treating geologic discontinuities and irregularities exposed in a foundation. In the four areas at Sugar Pine Dam where the dental concrete to rock contact surface was exposed for inspection, the bond was found to be excellent, even where the concrete was placed against decomposed to intensely weathered material in a shear zone. The methods and procedures used are thought to be reasonable. Placing dental concrete pneumatically expedited all phases of the dam embankment construction. No delays resulted from waiting for major areas to be formed or for concrete to be placed. The quantity of the concrete placed would have been much higher if it had to be formed. The use of a truck-mounted concrete pump with an articulated placing boom was the most efficient way of transporting concrete to any part of the dam foundation. This equipment had the flexibility to pump into formed areas or into unformed irregularities. It was also able to shoot concrete over or into thin or restricted areas where protection against weathering was required. Using the concrete boom truck is an economical way of placing dental concrete, whether it be pumped or pneumatically applied. (Lantz-PTT)
W87-09158

ASSIGNMENT OF STRENGTH REQUIRMENTS OF CONCRETE FOR LARGE DAMS,
G. T. Mikeladze, V. B. Sudakov, and B. N. Malyshgev.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 7, p 394-397, July 1986. 3 fig, 8 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 11-13, July 1986.

Descriptors: *Concrete construction, *Dams, *Strength, *Design standards, Inguri station, USSR.

The present standards for hydraulic structures regulates the assignment of the strength grade of concrete, as a rule, at an age of 180 days. The experience gained in large dam construction in recent years has shown the expediency of referring the design strength grade of concrete to 365 days. This principle was convincingly demonstrated in the construction of the arch dam of the Inguri hydroelectric station. Because large dams are not put into operation for a considerable period of time after construction, the use of 365 day old core samples is not unrepresentative of the strength of the concrete, and their use ensures that a more accurate and less wasteful assessment of the concrete strength is made. It is concluded that the compressive strength of the concrete substantially increases after 180 days, and the coefficient of variation decreases at a smaller rate, and that this method is technically and economically expediant, saving about 20 kg per cubic meter of cement. (Ram-PTT)
W87-09354

DETECTION OF DEFECTS IN A GROUT CURTAIN BY GEOPHYSICAL METHODS,
For primary bibliographic entry see Field 8E.
W87-09358

CONCRETE TEMPERATURE CONTROL DURING DAM CONSTRUCTION,
Binnie and Partners, Consulting Engineers, 25 Newgate Street, Chester, UK.
N. C. Holladay.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 5, p 17-20, May 1987. 4 fig, 2 tab, 1 ref.

Descriptors: *Concrete technology, *Temperature effects, *Arch dams, *Cracking, *Failures, Saudi Arabia, Concretes, Dams, Stress, Construction.

Early thermal cracking in mass concrete structures is a common cause for concern during construction. The temperature control methods and related construction details used in the building of one particular mass concrete structure, an arch dam in Saudi Arabia, are described. Results of studies on the effectiveness of these measures are given, as are some typical early age concrete temperature measurements. (Author's abstract)
W87-09408

USE OF SILICA-FUME CONCRETE TO REPAIR A STILLING BASIN,
T. C. Holland.
International Water Power and Dam Construction IWPCDM, Vol. 39, No. 5, p 56, 61-62, May 1987. 2 tab, 8 ref.

Descriptors: *Stilling basins, *Concrete technology, *Silica-fume concrete, *Maintenance, *Kinzua dam, Costs, Economic aspects, Erosion, Abrasion, Concretes, Dams.

Concrete damage, caused by abrasion erosion, is a significant problem in stilling basins of major hydraulic structures. Because of the difficulty of dewatering these basins, repairs are usually quite expensive. The use of high-strength (86 MPa) silica-fume concrete for the repair of the stilling basin of the Kinzua dam, USA, offered an economical solution that could greatly extend the time between repairs. (Author's abstract)
W87-09413

HIGH PRESSURE GROUTING IN DEEP GOLD MINES,
Rodio (South Africa) (Pty) Ltd., P.O. Box 524 Isandovale (Tvl) 1600 Republic of South Africa.
For primary bibliographic entry see Field 4B.
W87-09592

8G. Materials

DEVELOPMENT OF A SIMPLIFIED COLUMN TEST FOR EVALUATION OF THICKNESS OF CAPPING MATERIAL REQUIRED TO ISOLATE CONTAMINATED DREDGED MATERIAL,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5G.
W87-09091

HIGH PRESSURE GROUTING IN DEEP GOLD MINES,
Rodio (South Africa) (Pty) Ltd., P.O. Box 524 Isandovale (Tvl) 1600 Republic of South Africa.
For primary bibliographic entry see Field 4B.
W87-09592

APPLICATION OF NEW CHEMICAL GROUTS IN STRENGTHENING AND SEALING OF SOILS,
Institute of Meteorology and Water Management, Warsaw (Poland).
B. Jacenkow, A. Balcerzak, W. Gizynski, M. Gnatowski, and A. Pietak.
IN: Water in Mining and Underground Works (El

Agua en la Mineria y Trabajos Subterraneos), Volumes I, 1984. SIAMOS 78. p 429-439, 8 fig, 2 tab, 8 ref.

Descriptors: *Grouting, *Resins, *Soil sealants, Model studies, Soil stabilization, Mining engineering.

The results of research on new ureaformaldehyde (MS-10) resin and acetone formaldehyde (AF-3) resin used for strengthening and sealing soils and rocks by grouting are presented. Grout properties were studied in the laboratory on isomorphic models and in the field by application to actual underground constructions. Results showed that the MS-10 and AF-3 grouts produced of cheap and available raw materials may be applied to many practical works in the field of laying foundations, underground building, hydraulic engineering and to underground water protection against pollution. (See also W87-09568) (Geiger-PTT)
W87-09594

8I. Fisheries Engineering

DISTRIBUTION AND RELATIVE ABUNDANCE OF THE NILE PERCH (LATES NILOTICUS (L.) PISCES: CENTROPOMIDAE) IN LAKE KAINJI, NIGERIA,
Kainji Lake Research Inst., New Bussa (Nigeria).
For primary bibliographic entry see Field 2H.
W87-08762

COMPARISON OF PARASITE FAUNA OF JUVENILE SOCKEYE SALMON (ONCORHYNCHUS NERKA) FROM SOUTHERN BRITISH COLUMBIAN AND WASHINGTON STATE LAKES,
Department of Fisheries and Oceans, Nanaimo (British Columbia). Pacific Biological Station.
For primary bibliographic entry see Field 2H.
W87-08792

QUANTITATIVE AND QUALITATIVE ASPECTS OF FISH CROP IN RELATION TO ENVIRONMENTAL QUALITY,
Academia Sinica, Luojiashan (China). Institute of Hydrobiology.
For primary bibliographic entry see Field 5C.
W87-08855

CADMIUM CONTAMINATION IN AMERICAN LOBSTER, HOMARUS AMERICANUS, NEAR A COASTAL LEAD SMELTER: USE OF MULTIPLE LINEAR REGRESSION FOR MANAGEMENT,
Department of Fisheries and Oceans, Halifax (Nova Scotia). Fisheries and Environmental Sciences.
For primary bibliographic entry see Field 5C.
W87-08882

HABITAT MODIFICATION AND FRESHWATER FISHERIES.
For primary bibliographic entry see Field 4C.
W87-09036

EFFECTS ON FISHERIES OF NON-BIOTIC MODIFICATIONS OF THE ENVIRONMENT IN THE EAST-DANUBE RIVER AREA,
Galati Univ., 6200 Galati, Romania.
For primary bibliographic entry see Field 6G.
W87-09038

FALL OF MIGRATORY FISH POPULATIONS AND CHANGES IN COMMERCIAL FISHERIES IN IMPOUNDED RIVERS IN POLAND,
Inland Fisheries Inst., Zabiniec, 05-500 Piaseczno, Poland.
For primary bibliographic entry see Field 6G.
W87-09039

REVIEW OF EFFECTS OF ENVIRONMENTAL DEGRADATION ON THE FRESHWATER STAGES OF ANADROMOUS FISH,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
For primary bibliographic entry see Field 2H.
W87-09042

ADVERSE EFFECTS OF CHANNELIZATION AND THEIR AMELIORATION,
Department of Fisheries and Forestry, Abbotstown, Castleknock (Ireland). Fishery Research Centre.
For primary bibliographic entry see Field 6G.
W87-09043

ROLE OF THE FISHERIES ENGINEER IN THE DESIGN AND EXECUTION OF ARTERIAL DRAINAGE SCHEMES,
Department of Fisheries and Forestry, Lesson Lane, Dublin 2 (Ireland).
C. J. McGrath.
IN: Habitat Modification and Freshwater Fisheries, Proceedings of a Symposium of the European Inland Fisheries Advisory Commission, Aarhus, Sweden, May 23-25, 1984. Butterworths, London, England. 1985. p 98-103, 1 fig, 7 ref.

Descriptors: *Fisheries, *Engineering, *Drainage systems, *Ireland, Design standards, Surveys, Regulations, Fish management, Economic aspects, Fish hatcheries.

An account is given of the role played by the Fisheries Engineer in preparation of the design and in the execution of arterial drainage in Ireland with descriptions of some of the measures that have been taken to offset adverse effects of drainage works on fish life and fishing, with comments on their efficacy. In Ireland, statutory responsibility for the design, execution and subsequent maintenance of arterial drainage works is entrusted to the Commissioners of Public Works, i.e. the Office of Public Works (OPW) whose activities are authorized and governed by the provisions of the Arterial Drainage Act, 1945. Of vital importance to the fishery interests are the particular provisions of the Act which nominate the OPW as the Drainage Authority for the State and which exempt it from complying with the provisions of the Fisheries Acts during drainage work. At the same time, the Act imposes on the Drainage Authority the obligation to do whatever the Minister for Fisheries and Forestry deems necessary to avoid injury to fisheries during the execution of a drainage scheme, or as a consequence of it. Armed with information from fisheries surveys, the design of the drainage channels can proceed and be suitably adjusted, where necessary, to adapt them to the needs of the fishery interest. This is comparatively easy to do at the design stage, but near impossible once this has been completed. The design stage (program of work and cost-benefit analysis), rehabilitation works (spawning and nursery areas and restocking), and post-drainage activity (barriers to fish, fish surveys and maintenance work) are all discussed. (See also W87-09036) (Lantz-PTT)
W87-09044

DREDGING OF RAPIDS FOR TIMBER-FLOATING IN FINLAND AND ITS EFFECTS ON RIVER-SPAWNING FISH STOCKS,
Finnish Game and Fisheries Research Inst., Helsinki (Finland).
For primary bibliographic entry see Field 6G.
W87-09045

REVIEW OF BROWN TROUT (SALMO TRUTTA) SPAWNING BEDS, INDICATING METHODS FOR THEIR RE-ESTABLISHMENT IN DANISH LOWLAND RIVERS,
Skanderborg Town Council, The Fishery Project, Adelgade 44, DK-8660 Skanderborg (Denmark).
For primary bibliographic entry see Field 2H.
W87-09047

AMELIORATIVE METHODS TO REINSTATE FISHERIES FOLLOWING LAND DRAINAGE OPERATIONS,
Thames Water Authority, Nugent House, Vastern Road, Reading, Berkshire RG18DB, UK.
For primary bibliographic entry see Field 6G.
W87-09048

EFFECT OF HABITAT MODIFICATION ON FRESHWATER FISHERIES IN LOWLAND AREAS OF EASTERN ENGLAND,
Anglian Water Authority, Ambury Road, Huntingdon, Cambridgeshire PE186NZ, UK.
For primary bibliographic entry see Field 2H.
W87-09050

WHITEFISH AND VENDACE STOCKS IN THE REGULATED LAKE PYHAJARVI, CENTRAL FINLAND,
Jyvaskyla, SF-40100 Jyvaskyla 10 (Finland). Environment Research Centre.
For primary bibliographic entry see Field 2H.
W87-09052

WATER LEVEL REGULATION OF LAKE INARI: IMPACTS AND COMPENSATION MEASURES,
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 2H.
W87-09053

DEVELOPMENT OF FISH STOCK AND FISH POPULATIONS IN LAKE INARI,
Finnish Game and Fisheries Research Inst., Inari (Finland). Fisheries Div.
For primary bibliographic entry see Field 2H.
W87-09054

FISH STOCKS AND FISHING IN THE LOKKA AND PORTTIPAHTA RESERVOIRS, NORTHERN FINLAND,
Finnish Game and Fisheries Research Inst., Inari (Finland). Fisheries Div.
For primary bibliographic entry see Field 2H.
W87-09056

ASSESSMENT OF THE FLOW REQUIREMENTS FOR UPSTREAM MIGRATION OF SALMONIDS IN SOME RIVERS OF NORTH-WEST ENGLAND,
North West Water Authority, Warrington, Cheshire, UK.
For primary bibliographic entry see Field 2H.
W87-09058

PHYSICAL STRUCTURE AND BROWN TROUT (SALMO TRUTTA FARIO) POPULATIONS IN SMALL DANISH LOWLAND STREAMS,
Ribe County Council, 35 Sorsigvej, DK-6760 Ribe (Denmark). Div. of Environmental Affairs.
For primary bibliographic entry see Field 2H.
W87-09059

EFFECT OF RECREATIONAL USES UPON AQUATIC ECOSYSTEMS AND FISH RESOURCES,
Inland Fisheries Inst., Bloc 5, 10-957, Olstyn-Kortowo (Poland).
For primary bibliographic entry see Field 6G.
W87-09060

AFFORESTATION AND FISHERIES,
Freshwater Fisheries Lab., Fascally, Pitlochry, Perthshire, UK. Dept. of Agriculture and Fisheries.
For primary bibliographic entry see Field 4C.
W87-09061

EFFECTS OF HABITAT MODIFICATION ON FRESHWATER CRAYFISH,
Finnish Game and Fisheries Research Inst., Helsinki (Finland).
For primary bibliographic entry see Field 4C.
W87-09062

NATURAL PROPAGATION AND HABITAT IMPROVEMENT - WASHINGTON, VOLUME

IIA - TUMWATER FALLS AND DRYDEN DAM FISH PASSAGE.
Bonneville Power Administration, Portland, OR.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as DE84-016026. Price codes: A10 in paper copy, A01 in microfiche. DOE/BP--246-Vol.2a., Final Report, April 1984. 218 p, 41 fig, 7 tab, 63 ref.

Descriptors: *Reservoir fisheries, *Fish ladders, *Project planning, *Salmon, *Trout, Dam effects, Fish passages, Fish migration, Fish populations, Design criteria, Cost analysis, Construction costs.

This engineering feasibility and predesign report is intended to appraise Bonneville Power Administration of findings on the Tumwater Falls and Dryden Dam Fish Passage Project. Tumwater Falls and Dryden Dam, both on the Wenatchee River in Washington, are abandoned hydropower generation sites that are maintained only for irrigation purposes at Dryden Dam. The present fishway facilities at both sites are inadequate to properly pass the anadromous fish runs which consist of spring and summer chinook salmon, sockeye salmon, coho salmon and steelhead trout. Predesign fishway schemes at the Tumwater Falls site involve a single vertical slotted fish ladder with 19 pools which would cost $993,000. Proposed facilities at Dryden Dam include vertical slotted ladders at the west bank and at the east bank which would cost a combind sum of $946,000. The effects of present passage facilities on anadromous fish stocks is addressed both quantitatively and qualitatively. The quantitative treatment assesses losses of adult migrants due to the structures and arrives at an estimated value of between $392,000 and $701,000 per year for both structures. The qualitative approach to benefits deals with the concept of stock vigor, and the need for passage improvements to help ensure the health of the anadromous fish stock. The report concludes that there is clearly a need to construct new passage facilities at both Tumwater Falls and Dryden dam. The facilities described in this report with some refinements would serve well. It is recommended that Bonneville Power Administration take the necessary steps toward final design and construction by performing physical model studies of the proposed ladder structures. (Geiger-PTT)
W87-09109

FISH DIVERSION IN HYDROPOWER INTAKE,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
A. J. Odgaard, M. P. Cherian, and R. A. Elder.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 113, No. 4, p 505-519, April 1987. 10 fig, 2 tab, 3 ref, 1 append.

Descriptors: *Diversion structures, *Hydraulic structures, *Hydraulic design, *Model studies, *Hydraulic engineering, *Hydroelectric plants, *Fish management, *Fish passages, *Screens, Engineering, Powerplants, Turbines, Flow, Flow characteristics, Dams, Gates, Wells.

Hydraulic model studies were conducted to develop a fish screening system to be used in the turbine intakes of Wanapum Development and Priest Rapids Development on the Columbia River, Washington. The system studied utilized a mechanical screen, installed through one of the gate wells, to produce a flow pattern that would deflect downstream migrating juvenile fish into the gate well for subsequent removal by a collection system. The simplicity in the design and relative ease in the installation, operation, and maintenance of the passive screens were all factors favorable to the choice of passive screens over traveling screens. By comparing data for passive screens in the two gate wells, it was determined that better results were obtained by placing the screen in the emergency gate well. With the optimum screen-assembly design for the emergency gate well, a gate-well flow of 7.1% of the intake flow was generated with a head loss of about one velocity head (K sub 1 = 1.1); the loss coefficient for the gate-well flow was K sub 2 = 1.5. (Doria-PTT)
W87-09197

SWIMMING PERFORMANCE OF FISHES ENDEMIC TO THE MISSOURI RIVER IN SOUTH DAKOTA,
South Dakota Univ., Vermillion. Dept. of Biology.
J. C. Schmulbach, D. H. Tunink, and A. E. Zittel.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-124842, A06 in paper copy, A01 in microfiche. July 1982. Fish and Wildlife Service, Kearneysville, WV. Eastern Energy and Land Use Team. 107 p, 5 fig, 6 tab, 88 ref. 2 append.

Descriptors: *Fish behavior, *Fish management, *Fish migration, *Flow velocity, *Habitats, *Structural engineering, *Species diversity, *Swimming, Fisheries, Fish populations, Flow rates, Revetments, Missouri River.

Critical (prolonged) and sustained swimming abilities of several abundant and representative fish species of the middle Missouri River were examined under field conditions. Experimentally determined swimming speeds were then compared with existing current velocities in various channelized and unchannelized habitats to assess the environmental compatibility of habitat current velocity with swimming ability. In general, Missouri River species can attain sustained swimming speeds which represent more than 70% of their mean critical speed. The relative swimming speeds (specific speeds) measured in standard lengths per second were inversely related to body length, age and sexual maturity of the fish. Empirically determined swimming speeds generally were compatible with species distribution within habitats. To facilitate upstream movement and increase species diversity in the river, the Corps of Engineers' notching program should be expanded. Some in-channel construction of sand filled revetments may also be necessary to create new shallow-water habitats. To insure upstream passage of all fish species, the current velocities around or through a structure should accommodate the poorest swimming species or provide frequent alternate areas of low current velocity. (Geiger-PTT)
W87-09496

FOCUS: FISHERIES OCEANOGRAPHY COOPERATIVE USERS SYSTEM,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 7C.
W87-09500

10. SCIENTIFIC AND TECHNICAL INFORMATION

10B. Reference and Retrieval

INFORMATION RETRIEVAL SYSTEM: IMPACTS OF WATER-LEVEL CHANGES ON USES OF FEDERAL STORAGE RESERVOIRS OF THE COLUMBIA RIVER; APPENDIX F: RIVOPR USER'S MANUAL,
Battelle Pacific Northwest Labs., Richland, WA.
P. J. Cowley, M. A. Simmons, and W. V. De Meir.
Available from the National Technical Information Service, Springfield, VA 22161, as DE83 000980, A05 in paper copy, A01 in microfiche. PNL-4467, App. F, September 1982. 87 p, 6 fig, DE-AC06-76RLO 1830.

Descriptors: *Information retrieval, *Water level fluctuations, *Reservoirs, Columbia River, Data storage and retrieval, RIVOPR data base.

This user's manual is a guide to the River Operations (RIVOPR) data base. The files contain several classes of information: site, uses, impacts, impact type (water level), impact by month, cross reference, citation, author, and keyword. Directions are given for obtaining information and studying relationships concerning the impact of water level changes on uses of reservoirs of the Columbia River. (Cassar-PTT)
W87-09477

10C. Secondary Publication And Distribution

OZONE FOR DRINKING WATER TREATMENT: A BIBLIOGRAPHY,
Rice (Rip G.), Inc., Ashton, MD.
For primary bibliographic entry see Field 5F.
W87-09147

MANUAL OF STREAM CHANNELIZATION IMPACTS ON FISH AND WILDLIFE,
Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 6G.
W87-09497

SUBJECT INDEX

ABLATION
In Situ Cosmogenic 3H, 14C, and 10Be for Determining the Net Accumulation and Ablation Rates of Ice Sheets,
W87-09249 2C

ABSCISIC ACID
Responses of Leaf Water Potential and Leaf Diffusive Resistance to Abscisic Acid, Water Stress and Low Temperature in Hibiscus esculentus: The Effect of Water Stress and ABA Pre-Treatments,
W87-09210 2D

ABSCISSION
Interaction of Euonymus scale (Homoptera:Diaspididae) Feeding Damage and Severe Water Stress on Leaff Abscission and Growth of Euonymus Fortunei,
W87-09344 2I

ABSORPTION
Solute Transport During Absorption and Infiltration: A Comparison of Analytical Approximations,
W87-08990 7C

ACCLIMATIZATION
Acclimation as a Factor Influencing Metal Criteria,
W87-08635 5C

ACCUMULATION
Effect of Irrigation on Persistent Toxicity of Insecticides Applied as Granules to Soil to Brown Plant Hopper and Rice Swarming Caterpillar,
W87-08897 5B

ACID MINE DRAINAGE
Microbially Mediated Leaching of Low-Sulfur Coal in Experimental Coal Columns,
W87-09393 5B

Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I and II.
W87-09568 2F

ACID PONDS
Comparative Effects of Mine Wastes on the Benthos of an Acid and an Alkaline Pond,
W87-08962 5C

ACID RAIN
Effects of an Acidic River, Caused by Acidic Rain, on Weight Gain, Steroidogenesis, and Reproduction in the Atlantic Salmon (Salmo salar),
W87-08651 5C

Tracer Study of Vertical Exchange by Cumulus Clouds,
W87-08699 2A

Impact of Simulated Acidic Precipitation on Quantity and Quality of a Field Grown Potato Crop,
W87-08789 5C

Effect of Polluted and Leached Snow Melt Waters on the Soil Bacterial Community--Quantitative Response,
W87-08874 5C

Chemistry of Tension Lysimeter Water and Lateral Flow in Spruce and Hardwood Stands,
W87-08926 5B

Analysis of the Impact of the Sudbury Smelters on Wet and Dry Deposition in Ontario,
W87-08942 5B

Rainfall Acidity as Related to Meteorological Parameters in Northern Quebec,
W87-08943 2B

15N/14N Ratios of Nitrate and Ammonium in Rain at Pretoria, South Africa,
W87-08944 2B

Spatial Variability in the Chemical Composition of Snowcover in a Small, Remote, Scottish Catchment,
W87-08945 5B

Scavenging of Atmospheric Sulfate by Arctic Snow,
W87-08947 2C

Two New Ground-Level Cloud Water Sampler Designs Which Reduce Rain Contamination,
W87-08948 7B

Theory and Practice in the Electrometric Determination of pH in Precipitation,
W87-08949 7B

Effects of Low Ambient pH on Perivitelline Fluid of Ambystoma maculatum (Shaw) Eggs,
W87-08963 5C

Kinetics of Sulfate Adsorption and Desorption by Cecil Soil Using Miscible Displacement,
W87-08995 2G

Dynamics of Sulfate Retention by Acid Forest Soils in an Acidic Deposition Environment,
W87-09008 5B

Forest Soil Organic Horizon Acidification: Effects of Temperature, Time, and Solution/Soil Ratio,
W87-09009 2G

Mobilization of Aluminum in a Natural Soil System: Effects of Hydrologic Pathways,
W87-09024 5B

Report of the Acid Rain Peer Review Panel.
W87-09107 5B

American West's Acid Rain Test,
W87-09160 5B

Atmospheric Pollutants in Natural Waters.
W87-09164 5B

Modeling of Atmospheric Wet Deposition,
W87-09165 5B

Modeling of Atmospheric Particulate Deposition to Natural Waters,
W87-09166 5B

Atmospheric Deposition of Acidity and Sulfur in Florida,
W87-09177 5B

Trace Metal and Strong Acid Composition of Rain and Snow in Northern Minnesota,
W87-09178 5B

Lichens as Monitors of Atmospheric Deposition,
W87-09181 5C

Pesticides in Fog,
W87-09229 5B

Influence of Simulated Acidic Rain on Vegetative and Reproductive Tissues of Cucumber (Cucumis sativus L.),
W87-09232 5C

Decrease in Precipitation Acidity Resulting From Decreased S04(2-) Concentration,
W87-09348 5B

Fate of Some Components of Acidic Deposition in Ombrotrophic Mires,
W87-09382 5B

Effects of Simulated Acidic Mist on Germination of Alternaria solani and Phytophthora infestans in vitro and their Infection Efficiency and Sporulation on Potato,
W87-09414 5C

Yield Reductions in Winter Barley Grown on a Range of Soils and Exposed to Simulated Acid Rain,
W87-09416 5C

Influence of Meltwater on the Amount and Composition of Groundwater in Quaternary Deposits in Finland,
W87-09460 2F

Vulnerability of Selected Lakes and Streams in the Middle Atlantic Region to Acidification: A Regional Survey,
W87-09476 5B

1984 Annual Report to the President and Congress: National Acid Precipitation Assessment Program.
W87-09479 5B

ACID RAIN EFFECTS
Effects of Simulated Acidic Mist on Germination of Alternaria solani and Phytophthora infestans in vitro and their Infection Efficiency and Sporulation on Potato,
W87-09414 5C

Yield Reductions in Winter Barley Grown on a Range of Soils and Exposed to Simulated Acid Rain,
W87-09416 5C

ACID SNOW
Effect of Polluted and Leached Snow Melt Waters on the Soil Bacterial Community--Quantitative Response,
W87-08874 5C

Spatial Variability in the Chemical Composition of Snowcover in a Small, Remote, Scottish Catchment,
W87-08945 5B

ACID SOIL
Dynamics of Sulfate Retention by Acid Forest Soils in an Acidic Deposition Environment,
W87-09008 5B

ACID STREAMS
Evaluation of Natural Tracers in an Acidic and Metal-Rich Stream,
W87-09021 7B

Vulnerability of Selected Lakes and Streams in the Middle Atlantic Region to Acidification: A Regional Survey,
W87-09476 5B

ACIDIC FUNCTIONAL GROUPS
Acidic Functional Groups of Humic Substances,
W87-09086 2K

ACIDIC WATER
Vulnerability of Selected Lakes and Streams in the Middle Atlantic Region to Acidification: A Regional Survey,
W87-09476 5B

ACIDIC WATERS
Effect of Polluted and Leached Snow Melt Waters on the Soil Bacterial Community--Quantitative Response,
W87-08874 5C

ACIDIFICATION
Forest Soil Organic Horizon Acidification: Effects of Temperature, Time, and Solution/Soil Ratio,
W87-09009 2G

ACIDITY
Effects of Low Ambient pH on Perivitelline Fluid of Ambystoma maculatum (Shaw) Eggs,
W87-08963 5C

Acid Neutralizing Capacity of Fine Soil Fractions,
W87-09180 2G

ACIDITY

Influence of Meltwater on the Amount and Composition of Groundwater in Quaternary Deposits in Finland,
W87-09460 2F

ACTINOMETRY

Potassium Ferrioxalate as Chemical Actinometer in Ultraviolet Reactors,
W87-09377 5F

ACTIVATED CARBON

Biodegradation of Phenols in an Integrated Activated Carbon Bed and Suspended Aerobic Biological Growth Reactor,
W87-08774 5D

Operational Variables and the Release of Colonized Granular Activated Carbon Particles in Drinking Water,
W87-08957 5F

Comparative Toxicity of SRC-I Wastewater to Aquatic Organisms,
W87-09106 5C

Overview of Point-of-Use Water Treatment Technology,
W87-09119 5F

Study of the Kinetics of the Adsorption by Activated Carbons of 2,4,5-Trichlorophenoxyacetic Acid from Aqueous Solution,
W87-09251 5D

Adsorption of 2,4,5-T by Active Carbons from Aqueous Solution,
W87-09254 5D

Biofilm Shearing Under Dynamic Conditions,
W87-09367 5D

Modeling for Process Scale-Up of Adsorption and Ion Exchange Systems,
W87-09446 5D

ACTIVATED SLUDGE

Movement of Oligotrophic Bacteria in Activated Sludge,
W87-08771 5D

Biodegradability of para-Dichlorobenzene and Its Behaviour in Model Activated Sludge Plants,
W87-09269 5D

Methanogenic Toxicity and Anaerobic Degradability of a Hydrolyzable Tannin,
W87-09278 5D

ACTIVATED SLUDGE PROCESS

Relationship Between Bench Scale and Prototype Activated Sludge Systems,
W87-09449 5D

Role of Kinetic Models for the Scale-Up of Biological Processes,
W87-09450 5D

Scale-Up of Activated Sludge and Trickling Filter Processes,
W87-09451 5D

Efficiency and Process: Stability of Single Stage and Multi-Stage Wastewater Treatment Plants,
W87-09452 5D

Scale-Up of Biological Wastewater Treatment Processes: Practical Experiences in the U.K.,
W87-09453 5D

Development of a Competitive Two-Stage Biological Treatment System: Results of Pilot Plants and Full Scale Plants,
W87-09454 5D

ACUTE TOXICITY TESTS

Acute Toxicity Tests,
W87-09281 5C

ADSORPTION

Adsorptive Behavior of Butyltin Compounds Under Simulated Estuarine Conditions,
W87-08730 5B

Kinetics of Sulfate Adsorption and Desorption by Cecil Soil Using Miscible Displacement,
W87-08995 2G

Systematic Approach to Adsorption on XAD-2 Resin for the Concentration and Analysis of Trace Organics in Water Below the (mu)g/l Level,
W87-09011 5A

Adsorption of Inorganic Pollutants in Aquatic Systems,
W87-09194 5B

Removal of Phenols by Adsorption on Fly Ash,
W87-09250 5D

Study of the Kinetics of the Adsorption by Activated Carbons of 2,4,5-Trichlorophenoxyacetic Acid from Aqueous Solution,
W87-09251 5D

Adsorption of 2,4,5-T by Active Carbons from Aqueous Solution,
W87-09254 5D

Desorption and Regeneration of Dye Colours from Low-Cost Materials,
W87-09279 5D

Prediction of Fixed-Bed Adsorber Removal of Organics in Unknown Mixtures,
W87-09369 5D

Modeling for Process Scale-Up of Adsorption and Ion Exchange Systems,
W87-09446 5D

AERATION

Wastewater Treatment System Applying Aeration-Cavitation Flotation Mechanism,
W87-08603 5D

Geometric Parameters and Efficiency of Diffused Air Systems,
W87-09437 5D

Significance of Oxygen Transfer Variables in the Sizing of Dome Diffuser Aeration Equipment,
W87-09438 5D

Optimization of Mechanical Aerators in a Hydraulic Two-Phase Flow Model and the Scale-Up of the Results for the Prototype,
W87-09439 5D

Investigation and Discussion of Techniques for Hypolimnion Aeration/Oxygenation,
W87-09481 5G

AERIAL APPLICATION

Assessment of Aerial Application of Oil Spill Dispersants,
W87-09533 5G

Aerial Application of Dispersants at the Ixtoc I Spill,
W87-09534 5G

AEROBIC CONDITIONS

Biodegradation of Phenols in an Integrated Activated Carbon Bed and Suspended Aerobic Biological Growth Reactor,
W87-08774 5D

AEROBIC DIGESTION

Rational Design of Aerobic Digestion System,
W87-09370 5D

AFRICA

Extreme Floods in Southern Africa Caused by Tropical Cyclone Domoina,
W87-09410 2F

AGGLOMERATION

Recovery of Organics from Tailings Pond Sludge Using Coke for Agglomeration,
W87-08602 5D

AGGRADATION

Shifting of the Kosi River, Northern India,
W87-08834 2E

Man-Induced Gradient Adjustment of the South Fork Forked Deer River, West Tennessee,
W87-09206 6G

AGGRADING RIVERS

Shifting of the Kosi River, Northern India,
W87-08834 2E

AGRICULTURAL LANDS

Temporal Observations of Surface Soil Moisture Using A Passive Microwave Sensor,
W87-08781 2G

AGRICULTURAL RUNOFF

Acute Toxicity of Emulsifiable Concentrations of Three Insecticides Commonly Found in Nonpoint Source Runoff into Estuarine Waters to the Mummichog, Fundulus heteroclitus,
W87-08881 5C

Impact of Agriculture on Surface Water in Ireland: Part II. Prospects for the Future,
W87-09200 4C

Hydrogeological Aspects of Agricultural Drainage in Ireland,
W87-09203 2E

AGRICULTURAL SEDIMENTS

Riparian Areas as Filters for Agricultural Sediment,
W87-09002 4A

AGRICULTURAL WASTES

Studies on Water Hyacinth as a Biological Filtre for Treating Contaminants from Agricultural Wastes and Industrial Effluents,
W87-08609 5D

Swine Lagoon Effluent Applied to Coastal Bermudagrass,
W87-09472 5D

AGRICULTURAL WATERSHEDS

Hydrogeological Aspects of Agricultural Drainage in Ireland,
W87-09203 2E

AGRICULTURE

Proposals for Agricultural Development of Wadi Dhuleil Catchment, Jordan,
W87-08739 3F

Stability and Instability of an Adaptive Resource Replacement Strategy in and Agroecological Production System,
W87-08784 6A

Use of Canopy Temperatures to Identify Water Conservation in Cotton Germplasm,
W87-08788 3F

Omaha Recycles Sludge in Agricultural Program,
W87-08808 5E

Agricultural Drainage Practices in Ireland,
W87-09202 4A

Irrigated Agriculture and Groundwater Quality--A Framework for Policy Development,
W87-09212 6A

Wetlands Policy Crisis: United States and United Kingdom,
W87-09215 6E

AGROECOLOGICAL SYSTEMS
Stability and Instability of an Adaptive Resource Replacement Strategy in and Agroecological Production System,
W87-08784 6A

AGRONOMY
Agronomic Measures for Soil and Water Conservation,
W87-08664 3F

AGROPYRON
Water Relations of Xeric Grasses in the Field: Interactions of Mycorrhizzas and Competition,
W87-09341 2I

AIR CONDITIONING
Outbreak of Legionnaires' Disease in Glasgow Royal Infirmary: Microbiological Aspects,
W87-08703 5C

AIR CURRENTS
Tropical Squall Line Observed During the COPT 81 Experiment in West Africa. Part I: Kinematic Structure Inferred from Dual-Doppler Radar Data,
W87-08939 2B

AIR-EARTH INTERFACES
Air/Soil Exchange Coefficients,
W87-08678 5B

AIR POLLUTION
Impact of Mesoscale Convective Systems on Regional Visibility and Oxidant Distributions during Persistent Elevated Pollution Episodes,
W87-08695 2B

Tracer Study of Vertical Exchange by Cumulus Clouds,
W87-08699 2A

Understanding the Origin of Radon Indoors--Building a Predictive Capability,
W87-08888 5B

Analysis of the Impact of the Sudbury Smelters on Wet and Dry Deposition in Ontario,
W87-08942 5B

Scavenging of Atmospheric Sulfate by Arctic Snow,
W87-08947 2C

Report of the Acid Rain Peer Review Panel.
W87-09107 5B

Atmospheric Pollutants in Natural Waters.
W87-09164 5B

Modeling of Atmospheric Particulate Deposition to Natural Waters,
W87-09166 5B

Transfer Rates of Gaseous Pollutants Between the Atmosphere and Natural Waters,
W87-09167 5B

Atmospheric Deposition of Nitrogen and Phosphorus in Florida,
W87-09175 5B

Transport and Dry Deposition of Trace Metals over Southern Lake Michigan,
W87-09179 5B

Lichens as Monitors of Atmospheric Deposition,
W87-09181 5C

Atmospheric Lead and Zinc Deposition into Lakes of the Eastern United States,
W87-09183 5B

Atmospheric Concentrations and Deposition of Polychlorinated Biphenyls to Lake Superior,
W87-09185 5B

Aerial Deposition of Organochlorines in Urban and Coastal South Carolina,
W87-09188 5B

AIR POLLUTION EFFECTS
Impact of Mesoscale Convective Systems on Regional Visibility and Oxidant Distributions during Persistent Elevated Pollution Episodes,
W87-08695 2B

Influence of Sulfur Gas on Water Loss Rate,
W87-08707 2I

Model for Predicting the Influence of Moisture Stress on Crop Losses Caused by Ozone,
W87-08783 2I

Impact of Simulated Acidic Precipitation on Quantity and Quality of a Field Grown Potato Crop,
W87-08789 5C

Chemistry of Tension Lysimeter Water and Lateral Flow in Spruce and Hardwood Stands,
W87-08926 5B

Forest Soil Organic Horizon Acidification: Effects of Temperature, Time, and Solution/Soil Ratio,
W87-09009 2G

Mobilization of Aluminum in a Natural Soil System: Effects of Hydrologic Pathways,
W87-09024 5B

AIR POLLUTION SOURCES
Understanding the Origin of Radon Indoors--Building a Predictive Capability,
W87-08888 5B

AIR STRIPPING
Air-Water Phase Equilibria of Volatile Organic Solutes,
W87-08956 5F

AIR-WATER INTERFACES
Air/Water Exchange Coefficients,
W87-08679 5B

Mechanisms of Enrichment at the Air-Water Interface,
W87-09169 5B

Principles and Problems of Modeling Cation Enrichment at Natural Air-Water Interfaces,
W87-09170 5B

Copper in Marine Microlayers: Accumulation, Speciation and Transport,
W87-09172 5B

ALABAMA
Annual Macroinvertebrate Sampling - A Low-Cost Tool for Ecological Assessment of Effluent Impact,
W87-09325 5C

ALABAMA RIVER
Computation of Unsteady Flows in the Alabama River,
W87-08980 2E

ALASKA
Focus: Fisheries Oceanography Cooperative Users System,
W87-09500 7C

Distribution of Aromatic Hydrocarbons in Port Valdez, Alaska,
W87-09513 5B

Toxicity of Ballast-Water Treatment Effluent to Marine Organisms at Port Valdez, Alaska,
W87-09514 5C

Wreck of the Lee Wang Zin,
W87-09528 5G

ALDICARB
Nonpoint Agricultural Pollution: Pesticide Contamination of Groundwater Supplies,
W87-09213 5B

ALGAE
Interrelationships of Algae and Bacteria During Methane Oxidation,
W87-08712 2H

Algal Phagotrophy: Regulating Factors and Importance Relative to Photosynthesis in Dinobryon (Chrysophyceae),
W87-08929 2H

Freshly Prepared Rat Hepatocytes Used in Screening the Toxicity of Blue-Green Algal Blooms,
W87-09230 5A

Effects of Exposure Time, Season, Substrate Type, and Planktonic Populations on the Taxonomic Composition of Algal Periphyton on Artificial Substrates in the Ohio and Little Miami Rivers, Ohio,
W87-09321 5C

ALGAL GROWTH
Toxic Effects of Organic Solvents on the Growth of Blue-Green Algae,
W87-09236 5C

ALGAL PHAGOTROPHY
Algal Phagotrophy: Regulating Factors and Importance Relative to Photosynthesis in Dinobryon (Chrysophyceae),
W87-08929 2H

ALGAL TOXINS
Freshly Prepared Rat Hepatocytes Used in Screening the Toxicity of Blue-Green Algal Blooms,
W87-09230 5A

ALGICIDES
Induction of Siderophore Activity in Anabaena spp. and Its Moderation of Copper Toxicity,
W87-09386 5G

ALGORITHMS
Determining Optimum Pumping Rates for Creation of Hydraulic Barriers to Ground-Water Pollutant Migration,
W87-09108 5G

ALKALINE PONDS
Comparative Effects of Mine Wastes on the Benthos of an Acid and an Alkaline Pond,
W87-08962 5C

ALKALINITY
Role of Gas Exchange in the Inorganic Carbon, Oxygen, and 222Rn Budgets of the Amazon River,
W87-08871 2H

ALLUVIAL FANS
Shifting of the Kosi River, Northern India,
W87-08834 2E

ALLUVIAL PLAINS
Shifting of the Kosi River, Northern India,
W87-08834 2E

ALLUVIAL STREAMS
Mechanics of Sediment Transportation and Alluvial Stream Problems,
W87-09337 2J

ALTERNARIA
Effects of Simulated Acidic Mist on Germination of Alternaria solani and Phytophthora infestans in vitro and their Infection Efficiency and Sporulation on Potato,
W87-09414 5C

ALUMINUM

ALUMINUM
Determination of Monomeric and Polynuclear Aluminum(III) Species and Hydrolysis Constants,
W87-08611 1B

Mobilization of Aluminum in a Natural Soil System: Effects of Hydrologic Pathways,
W87-09024 5B

AMAZON RIVER
Role of Gas Exchange in the Inorganic Carbon, Oxygen, and 222Rn Budgets of the Amazon River,
W87-08871 2H

AMBYSTOMA
Effects of Low Ambient pH on Perivitelline Fluid of Ambystoma maculatum (Shaw) Eggs,
W87-08963 5C

AMES TEST
Absence of Mutagenic and Antimutagenic Activities of Fluoride in Ames Salmonella Assays,
W87-09405 5C

AMINO ACIDS
Free Amino Acids in Lakes: Concentrations and Assimilation Rates in Relation to Phytoplankton and Bacterial Production,
W87-08868 2H

Kinetics and Mechanisms of Hypochlorite Oxidation of alpha-Amino Acids at the Time of Water Disinfection (Cinetiques et Mechanismes de l'Action Oxydative de l'Hypochlorite sur les Acides alpha-Amines lors de la Desinfection des Eaux),
W87-09274 5F

Free Amino Acids in Marine Rains: Evidence for Oxidation and Potential Role in Nitrogen Cycling,
W87-09349 2B

AMMONIA
Ammonia, Hydrogen Sulphide and Methyl Mercaptides in Finnish Municipal Sewage Plants and Pumping Stations,
W87-08725 5D

Removal of Ammonia and Other Nitrogen Derivatives from Drinking Water with Ozone,
W87-09141 5F

Ammonia, Nitrite, and Nitrate,
W87-09294 5C

AMMONIUM
15N/14N Ratios of Nitrate and Ammonium in Rain at Pretoria, South Africa,
W87-08944 2B

AMMONIUM BICARBONATE
Ammonium Bicarbonate-DTPA and DTPA Extractions of Sludge-Amended Soils,
W87-08923 5A

AMPHIPODS
Digestion of Carbohydrates and Protein by Gammarus mucronatus Say (Amphipoda),
W87-08839 2L

AMPLIFIED-ELISA
A-ELISA to Detect Hepatitis A Virus in Estuarine Samples,
W87-09396 5A

ANABAENA
Induction of Siderophore Activity in Anabaena spp. and Its Moderation of Copper Toxicity,
W87-09386 5G

ANADROMOUS FISH
Review of Effects of Environmental Degradation on the Freshwater Stages of Anadromous Fish,
W87-09042 2H

ANAEROBIC DIGESTION
Anaerobic Treatment of Distillery Slops Using an Upflow Anaerobic Filter Reactor,
W87-08890 5D

Management of Industrial Pollutants by Anaerobic Processes,
W87-09190 5D

Economics of the Treatment of Dairy Cow Slurry by Anaerobic Digestion,
W87-09216 5D

Methanogenic Toxicity and Anaerobic Degradability of a Hydrolyzable Tannin,
W87-09278 5D

ANALYTICAL METHODS
Electrochemical Analysis of Organic Pollutants,
W87-08612 5A

Isolation of Mutagenic Components by High-Performance Liquid Chromatography from XAD Extract of Water from the Nishitakase River, Kyoto City, Japan,
W87-08723 5A

Method for Measuring Selective Light Attenuation within a Periphytic Community,
W87-08769 7B

Determination of Cobalt, Copper, Mercury, and Nickel as Bis(2-hydroxyethyl)dithiocarbamate Complexes by High-Performance Liquid Chromatography,
W87-08831 5A

Determination of Trace Metals in a River Water Reference Material by Inductively Coupled Plasma Mass Spectrometry,
W87-08832 5A

Spectrophotometric Determination of Traces of Silicon in Water after Collection as Silicomolybdenum Blue on an Organic-Solvent-Soluble Membrane Filter,
W87-08833 5A

Complete HF Digestion Method for Element and Trace Element Determination in Soils, Sediments, Sludges and Other Similar Samples Using a Closed System (HF-Totalaufschluss im geschlossenen System fur Element- und Spurenelementbestimmungen in Boden, Klarschlamm, Sedimenten u. a. Proben),
W87-08894 5A

Research in Environmental Pollution: II. Determination of Polychlorinated Nitrobenzenes (PCNB's) in Main River Fish,
W87-08895 5A

Analysis of Pentachlorophenol in Water and Urine by Enrichment with Lipidex(R) 5000,
W87-08896 5A

'Spray-Column' Laboratory Apparatus for Organic Matter Extraction from Sludges,
W87-08913 5A

Effect of Storage on the Distribution of Trace Elements (Lead, Cadmium, Copper, Zinc and Mercury) in Natural Water,
W87-08914 5A

Ammonium Bicarbonate-DTPA and DTPA Extractions of Sludge-Amended Soils,
W87-08923 5A

Simultaneous Measurement of Primary Production by Whole-Lake and Bottle Radiocarbon Additions,
W87-08931 2H

Sedimentation and Bioturbation in a Salt Marsh as Revealed by 210Pb, 137Cs, and 7Be Studies,
W87-08932 2L

Photosynthesis and Light Adaptation in Epiphyte-Macrophyte Associations Measured by Oxygen Microelectrodes,
W87-08935 7B

Thymidine Incorporation and Microbial Respiration in the Surface Sediment of a Hypereutrophic Lake,
W87-08936 2H

Occurrence, Significance, and Detection of Klebsiella in Water Systems,
W87-08958 5A

Chromatographic Studies of Dissolved Organic Matter and Copper-Organic Complexes Isolated From Estuarine Waters,
W87-08960 7B

Accuracy of Selective Extraction Procedures for Metal Speciation in Model Aquatic Sediments,
W87-08985 5A

Determination of Low Levels of Cationic Polyelectrolytes in Water,
W87-08986 5A

Systematic Approach to Adsorption on XAD-2 Resin for the Concentration and Analysis of Trace Organics in Water Below the (mu)g/l Level,
W87-09011 5A

Gas Chromatographic Analysis of Volatile Compounds in Water and Biological Samples with an Automatic Injector,
W87-09012 7B

Theory of Fluorescent Irradiance Fields in Lakes and Seas,
W87-09193 5A

Determination of Toxic Organophosphorus Compounds by Specific and Nonspecific Detectors,
W87-09220 5A

New Method for Determining the Concentrations of Volatile Organic Compounds in Sediment Interstitial Water,
W87-09233 5A

Attempt to Measure the Flow of Chlorinated Hydrocarbons, such as PCBs, from Water to Air in the Field,
W87-09246 7B

Quantification of PCB by Dechlorination to Biphenyl,
W87-09259 5A

Gas-Chromatographic Determination of Total Polychlorinated Aromates and Chloro-Paraffins Following Catalytic Reduction in the Injection Port,
W87-09260 5A

On-Line Sulphate Monitoring by Reversed Flow Injection Analysis and Alternating Reagent Injection,
W87-09261 5A

Stroboscopic Determination of Settling Velocity, Size and Porosity of Activated Sludge Flocs,
W87-09263 7B

Use of Monodispersed, Fluorescently Labeled Bacteria to Estimate In Situ Protozoan Bacterivory,
W87-09388 2H

Comparison of the Hydrophobic-Grid Membrane Filter Procedure and Standard Methods for Coliform Analysis of Water,
W87-09392 5A

A-ELISA to Detect Hepatitis A Virus in Estuarine Samples,
W87-09396 5A

Evaluation of the Multitest Medium for Rapid Presumptive Identification of Vibrio cholerae from Environmental Sources,
W87-09397 5A

ANASAZI
Dolores Archaeological Program: Anasazi Communities at Dolores: Early Anasazi Sites in the Sagehen Flats Area,
W87-09330 6G

ANILINES
Degradation of Aniline and Chloroanilines by Sunlight and Microbes in Estuarine Water,
W87-09271 5B

ANIMAL POPULATIONS
Effects of Food Availability and Fish Predation on a Zooplankton Community,
W87-08799 2H

ANIMAL WASTES
Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: I. Persistence, Yield, Quality, and Elemental Removal,
W87-08919 5C

Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: II. Rainfall Runoff and Soil Chemical Properties,
W87-08920 5C

Economics of the Treatment of Dairy Cow Slurry by Anaerobic Digestion,
W87-09216 5D

ANIONIC POLYMERS
Application of Soil Conditioner Solutions to Soil Columns to Increase Water Stability of Aggregates,
W87-09005 2G

ANIONS
Removal of Multivalent Metal Cations from Water Using Micellular-Enhanced Ultrafiltration,
W87-09223 2K

ANNUAL RUNOFF
Operational Spring Time Forecasting Difficulties and Improvements,
W87-08824 2E

ANTARCTIC
Photosynthate Distribution by Microplankton in Permanently Ice-Covered Antarctic Desert Lakes,
W87-08872 2H

ANTIBIOTICS
Antibiotic-Resistant Pseudomonas in Bottled Drinking Water,
W87-09424 5F

ANTIMONY
Removal of Antimony from Aqueous Systems,
W87-08604 5F

AQUACULTURE
Quantitative and Qualitative Aspects of Fish Crop in Relation to Environmental Quality,
W87-08855 5C

AQUATIC BACTERIA
Free Amino Acids in Lakes: Concentrations and Assimilation Rates in Relation to Phytoplankton and Bacterial Production,
W87-08868 2H

Sestonic Bacteria as a Food Source for Filtering Invertebrates in Two Southeastern Blackwater Rivers,
W87-08870 2H

AQUATIC ECOSYSTEMS
Effect of Recreational Uses Upon Aquatic Ecosystems and Fish Resources,
W87-09060 6G

AQUATIC ENVIRONMENT
What Industry is Doing to Protect Aquatic Life,
W87-08628 5G

Research Needs in Developing Structure Activity Relationships,
W87-08633 5C

Aquatic Hazard Assessment: Picloram,
W87-08643 5C

Rapid Aquatic Toxicity Assay Using Incorporation of Tritiated-Thymidine into Sea Urchin, Arbacia punctulata, Embryo: Evaluation of Toxicant Exposure Procedures,
W87-08655 5C

Comparative Metabolism of Fenitrothion in Aquatic Organisms: I. Metabolism in the Euryhaline Fish, Oryzias latipes and Mugil cephalus,
W87-08859 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: II. Metabolism in the Freshwater Snails, Cipangopaludina japonica and Physa acuta,
W87-08860 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: III. Metabolism in the Crustaceans, Daphnia pulex and Palaemon paucidens,
W87-08861 5B

Effect of Mosquito Killer Insecticides on Freshwater Mussels,
W87-08908 5C

Isolation and Concentration Techniques for Aquatic Humic Substances,
W87-09080 2H

Fractionation Techniques for Aquatic Humic Substances,
W87-09082 7B

Principles of Aquatic Chemistry,
W87-09305 2K

Evaluation of the Effects of Effluents on Aquatic Life in Receiving Waters - An Overview,
W87-09312 5C

Environmental Impact Analysis of Aquatic Ecosystems Using Rational Threshold Value Methodologies,
W87-09313 5C

Impact of Trinitrotoluene Wastewaters on Aquatic Biota in Lake Chickamauga, Tennessee,
W87-09322 5C

Aquatic Chemistry: An Introduction Emphasizing Chemical Equilibria in Natural Waters,
W87-09340 2A

AQUATIC HABITATS
Habitat Modification and Freshwater Fisheries.
W87-09036 4C

Manual of Stream Channelization Impacts on Fish and Wildlife,
W87-09497 6G

AQUATIC INSECTS
Acute Toxicity of Brestan and Fentin Acetate on Some Freshwater Organisms,
W87-08876 5C

AQUATIC LIFE
Multispecies Tests: Research Needs to Assess the Effects of Chemicals on Aquatic Life,
W87-08632 5A

Acute Toxicity of Chlorine on Freshwater Organisms: Time-Concentration Relationships of Constant and Intermittent Exposures,
W87-08640 5C

AQUATIC PLANTS
Qualitative Model of Eutrophication in Macrophyte Lakes,
W87-08785 2H

Use of Bog Vegetation as a Monitor of Atmospheric Input of Metals,
W87-09182 5C

Evaluation of the Model CE-QUAL-R1 for Use by the Aquatic Plant Control Research Program,
W87-09486 5B

AQUATIC TOXICITY
Early Life Stage Toxicity Tests,
W87-09282 5C

Chronic Toxicity Tests,
W87-09283 5C

Factors that Modify Toxicity,
W87-09285 5C

Toxicity of Chemical Mixtures,
W87-09286 5C

Microbial Toxicity Studies,
W87-09287 5C

AQUATIC TOXICOLOGY
Aquatic Toxicology and Hazard Assessment: Eighth Symposium.
W87-08624 6E

Scientific Considerations in the Legislative Arena,
W87-08625 6E

Scientific Considerations in the International Arena,
W87-08626 6E

Fundamentals of Aquatic Toxicology: Methods and Applications.
W87-09280 5C

Histopathology,
W87-09290 5C

Pesticides,
W87-09291 5C

Trace Metals,
W87-09292 5C

Polycyclic Aromatic Hydrocarbons,
W87-09293 5C

Ammonia, Nitrite, and Nitrate,
W87-09294 5C

Fate Modeling,
W87-09298 5B

Environmental Legislation,
W87-09299 6E

Field Validation,
W87-09300 7A

Chemical Safety Evaluation,
W87-09301 5B

Effluent Evaluation,
W87-09302 5A

Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms.
W87-09311 5C

AQUATIC WEED CONTROL
Biological Control of Aquatic Weeds: The Efficacy of Hybrid Grass Carp in Two Southern California Irrigation Canals,
W87-09480 4A

AQUATIC WEEDS
Regulation of Submerged Aquatic Plant Distribution in a Uniform Area of a Weedbed,
W87-08836 2H

AQUEOUS SOLUTIONS
Removal of Antimony from Aqueous Systems,
W87-08604 5F

Removal of Traces of Pentachlorophenol from Aqueous Acidic Solutions by Solvent Extraction and Solvent Sublation,
W87-08605 5D

Separation of Mercury from Aqueous Mercuric Chloride Solutions by Onion Skins,
W87-08606 5D

Determination of Monomeric and Polynuclear Aluminum(III) Species and Hydrolysis Constants,
W87-08611 1B

AQUIFER DIFFUSIVITY
Diffusivity of a Glacial-Outwash Aquifer by the Floodwave-Response Technique,
W87-08754 2F

AQUIFER TESTING
Performance and Analysis of Aquifer Tracer Tests with Implications for Contaminant Transport Modeling - A Project Summary,
W87-08759 5B

Predictive Application of an ORNL Geohydrology Model,
W87-08760 7C

AQUIFER TESTS
Alternate Procedure for Analyzing Aquifer Tests Using the Theis Nonequilibrium Solution,
W87-08756 7C

AQUIFERS
Hydraulic/Chemical Changes During Ground-Water Recharge by Injection,
W87-08751 5B

Profiles of Nitrogen Species in a Sand-Silt Aquifer at Haslemoen, Solor, South Norway,
W87-08818 5B

Stochastic Modelling of a Contaminated Aquifer: The Unconditional Approach,
W87-08820 5B

Statistical Structure and Filter Characteristics of Tritium Fluctuations in Fractured Basalt,
W87-09027 5B

Humic Substances in Groundwater,
W87-09070 2F

Ground Water Pollution Control,
W87-09150 5G

Subglacial Drainage for an Ice Sheet Resting Upon a Layered Deformable Bed,
W87-09248 2F

Maintenance and Stability of Introduced Genotypes in Groundwater Aquifer Material,
W87-09391 5B

Water-Quality Monitoring at the Hoe Creek Test Site: Review and Preliminary Conclusions,
W87-09495 5B

Water Hazard in Deep Gold Mining of the Far West Witwatersrand - South Africa,
W87-09588 2F

ARAVA VALLEY
Hydrology,
W87-08662 2A

ARCH DAMS
Arch Dam of the Khudoni Hydroelectric Station,
W87-09353 8A

Concrete Temperature Control During Dam Construction,
W87-09408 8F

ARCHAEOLOGY
Settlement, Subsistence, and Specialization in the Northern Periphery: Research Design for Mitigative Data Recovery at Sites in the New Waddell Dam Borrow Areas,
W87-09094 6G

History of the Carlsbad Basin, Southeastern New Mexico,
W87-09151 6G

Prehistory of the Carlsbad Basin, Southeastern New Mexico,
W87-09156 6G

Report on Additional Human Skeletal Material Exposed by Reservoir Induced Erosion at Lake Altus, Southwestern Oklahoma,
W87-09161 6G

Ellisford Cremations: Internecine Hostilities in the 5th Century A.D.,
W87-09162 6G

Prehistoric Hunter-Gatherers of South Central Arizona: The Picacho Reservoir Archaic Project,
W87-09191 6G

Yakima River Basin Historical Resource Survey, Volume I: Overview and Management Recommendations,
W87-09192 6G

Tucson Aqueduct Phase B Central Arizona Project: Archaeological Data Recovery Studies, 1985-1986 Annual Report,
W87-09329 6G

Dolores Archaeological Program: Anasazi Communities at Dolores: Early Anasazi Sites in the Sagehen Flats Area,
W87-09330 6G

Cultural Resource Inventory of Fresno Reservoir, Hill County, Montana,
W87-09331 6G

Prehistoric Cultural Resources Study Predictive Model and Field Survey Weber Basin Project,
W87-09335 6G

Roman Dams in Southern Portugal,
W87-09411 6E

Archaeological and Historical Surveys of Selected Portions of the Umatilla Basin Project, Umatilla County, Oregon,
W87-09425 6G

ARCTIC
Ecological and Physiological Differentiation Among Low-Arctic Clones of Daphnia Pulex,
W87-08691 2H

ARCTIC SNOW
Scavenging of Atmospheric Sulfate by Arctic Snow,
W87-08947 2C

ARID CLIMATES
Recovery of Water from Atmospheric Air in Arid Climates,
W87-08601 5F

ARID ZONE
Linear Regression Model Combined with a Soil Water Balance Model to Design Micro-Catchments for Water Harvesting in Arid Zones,
W87-08738 3B

ARIZONA
Regulatory Dilemmas Ensnare Arizona's Small Water Companies,
W87-08952 5F

Institutional Analysis in Community Decision-Making: A Case Example from Southern Arizona,
W87-08981 6A

Preventing Desert Mule Deer Drownings in the Mohawk Canal, Arizona,
W87-09152 6G

Coolidge Dam: Photographs Written Historical and Descriptive Data Reduced Copies of Drawings,
W87-09163 8A

Yakima River Basin Historical Resource Survey, Volume I: Overview and Management Recommendations,
W87-09192 6G

Tucson Aqueduct Phase B Central Arizona Project: Archaeological Data Recovery Studies, 1985-1986 Annual Report,
W87-09329 6G

ARKANSAS
Seasonal Effects on Ground-Water Chemistry of the Ouachita Mountains,
W87-09428 2K

AROMATIC COMPOUNDS
Biodegradation of Trichloroethylene and Involvement of an Aromatic Biodegradative Pathway,
W87-09387 5D

AROMATIC HYDROCARBONS
Atmospheric Deposition of Particulate Organic Carbon and Polyaromatic Hydrocarbons to Lake Michigan,
W87-09187 5B

Polycyclic Aromatic Hydrocarbons,
W87-09293 5C

ARSENIC
Quantities of Cadmium, Lead, Mercury and Arsenic Entering the U.K. Environment from Human Activities,
W87-08728 5B

Transport of Arsenic and Mercury from Gold Mining Activities Through an Aquatic System,
W87-08731 5B

ARTIFICIAL RECHARGE
Artificial Ground Water Recharge by Flooding During Grapevine Dormancy,
W87-08979 2F

Removal of Individual Off-Flavour Compounds in Water During Artificial Groundwater Recharge and During Treatment by Alum Coagulation/Sand Filtration,
W87-09267 5F

Influence of Underground Constructions in Crystalline Rock on Groundwater Conditions and the Use of Artificial Recharge to Restore a Lowered Piezometric Surface,
W87-09589 4B

ASBESTOS
Asbestos Fibres Introduce Trace Metals into Streamwater and Sediments,
W87-08912 5B

ASH
Establishment of Biotic Communities Within a Newly Constructed Ash Settling Basin and Its Drainage System,
W87-09323 5E

ASPHALT CAPS
Evaluating Asphalt Cap Effectiveness at Superfund Site,
W87-09379 5E

ASSIMILATIVE CAPACITY
Free Amino Acids in Lakes: Concentrations and Assimilation Rates in Relation to Phytoplankton and Bacterial Production,
W87-08868 2H

ASTEROIDEA
Chlorinated Insecticides and PCBs in Asteroidea and Holothuroidea Species from Rijeka Bay, Yugoslavia,
W87-08724 5B

ATMOSPHERIC DEPOSITION
Atmospheric Deposition of Nitrogen and Phosphorus in Florida,
W87-09175 5B

Atmospheric Concentrations and Deposition of Polychlorinated Biphenyls to Lake Superior,
W87-09185 5B

Atmospheric Deposition of Particulate Organic Carbon and Polyaromatic Hydrocarbons to Lake Michigan,
W87-09187 5B

Aerial Deposition of Organochlorines in Urban and Coastal South Carolina,
W87-09188 5B

ATMOSPHERIC DESPOSITION
Inputs of Polychlorinated Biphenyls from the Atmosphere to Lakes Huron and Michigan,
W87-09186 5B

ATMOSPHERIC FLUXES
Importance of Atmospheric Fluxes to the Nitrogen Balance of Lakes in the Florida Peninsula,
W87-09176 2H

ATOMIC ABSORPTION SPECTROSCOPY
Some Metals and Their Possible Sources in Rain Water of the Southern Baltic Coast, 1976 and 1978-1980,
W87-08726 5B

AUBURN
Foundation Treatment Using Pneumatically Applied Concrete,
W87-09158 8F

AUGER HOLES
Determination of Hydraulic Conductivity from Auger Holes and Pits - An Approximation,
W87-08617 2F

AUTOMATIC INJECTORS
Gas Chromatographic Analysis of Volatile Compounds in Water and Biological Samples with an Automatic Injector,
W87-09012 7B

AUTOMATION
Digital Controller for Discrete Stage Activation of Automatic Pumping Samplers,
W87-08983 7B

On-Line Sulphate Monitoring by Reversed Flow Injection Analysis and Alternating Reagent Injection,
W87-09261 5A

Programmed Closing of Gates Upon Loss of Drive by a Pump Unit,
W87-09355 8C

BACKWASHING
Expansion of Granular Filters During Backwashing,
W87-09371 5D

Comparison of Backwash Models for Granular Media,
W87-09372 5D

BACTERIA
Interrelationships of Algae and Bacteria During Methane Oxidation,
W87-08712 2H

Bacteria as Structuring Agents in Lakes: Field Manipulations with Bacterioplankton,
W87-08768 2H

Growth of Mixed Microbial Populations in Ground Water Containing Highly Chlorinated Organic Wastes,
W87-08878 5B

Biodegradability of para-Dichlorobenzene and Its Behaviour in Model Activated Sludge Plants,
W87-09269 5D

Use of Monodispersed, Fluorescently Labeled Bacteria to Estimate In Situ Protozoan Bacterivory,
W87-09388 2H

Maintenance and Stability of Introduced Genotypes in Groundwater Aquifer Material,
W87-09391 5B

BACTERIOLOGY
Bacteriological Quality of Drinks From Vending Machines,
W87-08704 5F

BACTERIOPLANKTON
Bacteria as Structuring Agents in Lakes: Field Manipulations with Bacterioplankton,
W87-08768 2H

BACTERIVORY
Use of Monodispersed, Fluorescently Labeled Bacteria to Estimate In Situ Protozoan Bacterivory,
W87-09388 2H

BAETIS
Life Cycles of Four Species of Baetis (Ephemeroptera) in Three Danish Streams,
W87-08764 2H

BAFFLES
Development of a New Type of Fluidized Bed Reactor,
W87-09444 5D

BALDEGGERSEE
Structure and Dynamics of Internal Waves in Baldeggersee,
W87-08864 2H

BALTIC COAST
Some Metals and Their Possible Sources in Rain Water of the Southern Baltic Coast, 1976 and 1978-1980,
W87-08726 5B

BANK PROTECTION
Streambank Protection by Submerged Vanes,
W87-09198 4D

BARLEY
Yield Reductions in Winter Barley Grown on a Range of Soils and Exposed to Simulated Acid Rain,
W87-09416 5C

BASE FLOW
Estimating Baseflow Volume and its Uncertainty,
W87-08971 2E

BASELINE STUDIES
Stream Water Quality in the Coal Region of Virginia,
W87-09494 4C

BASINS
Water Quality Beneath Urban Runoff Water Management Basins,
W87-08967 2F

Use of Topological Information in Hydrograph Estimation,
W87-08976 2E

Carolina Bays on the Eastern Shore of Maryland: I. Soil Characterization and Classification,
W87-08999 2H

BASS
Effect of Ingested Benzo(a)pyrene and Cadmium on Tissue Accumulation, Hydroxylase Activity, and Intestinal Morphology of the Black Sea Bass, Centropristis striata,
W87-08842 5C

Spring and Summer Movements of Subadult Striped Bass, Morone saxatilis, in the Connecticut River,
W87-09253 2H

BATHING
Water Use and Health in Mueda, Mozambique,
W87-08777 5F

BAY OF BISCAY
Concentrations of Mercury in Near Shore Surface Waters of the Bay of Biscay and in the Gironde Estuary,
W87-08961 5A

BEARINGS
Measures to Reduce the Level of Vibrations of Turbine-Generator Units,
W87-09365 8C

BEAUFORT SEA
Dome's Petroleum Study of Oil and Gas Under Sea Ice,
W87-09525 5G

BEAVER PONDS
Effect of Beaver Ponds on the Nonpoint Source Water Quality of a Stream in Southwestern Wyoming,
W87-09265 2H

BED EVOLUTION
Analysis of Horizontally Two-Dimensional Morphological Evolutions in Shallow Water,
W87-08782 7C

BED LOAD
Heavy Metals Distribution in the Sediments of Ganges and Brahmaputra Rivers,
W87-09204 5B

BEETS
Effects of Cd(2+) and EDTA on Young Sugar Beets (Beta vulgaris). II. Net Uptake and Distribution of Mg(2+), Ca(2+), and Fe(2+)/Fe(3+),
W87-09228 2I

BEHAVIOR
Behavior,
W87-09288 5C

BENCHING
Engineering Measures for Soil and Water Conservation: Terracing and Benching,
W87-08667 3F

BENEFITS
Exploring Existence Value,
W87-09031 6C

Valuing Wildlife in Benefit-Cost Analyses: A Case Study Involving Endangered Species,
W87-09032 6B

BENEFITS

Estimating the Value of Water Quality Improvements in a Recreational Demand Framework,
W87-09033 6C

Modeling the Demand for Outdoor Recreation,
W87-09034 6D

BENTHIC ENVIRONMENT

Theory of Secondary Production Calculations for Continuously Reproducing Populations,
W87-08862 2L

Assessment and Prediction of Impacts of Effluents on Communities of Benthic Stream Macroinvertebrates,
W87-09324 5C

BENTHIC FAUNA

Hydrodynamics and Structure: Interactive Effects on Meiofauna Dispersal,
W87-08838 2L

BENTHOS

Comparative Effects of Mine Wastes on the Benthos of an Acid and an Alkaline Pond,
W87-08962 5C

BENZENES

Effectiveness of Offshore Produced Water Treatment,
W87-09515 5D

BENZO (A)PYRENE

Effect of Ingested Benzo(a)pyrene and Cadmium on Tissue Accumulation, Hydroxylase Activity, and Intestinal Morphology of the Black Sea Bass, Centropristis striata,
W87-08842 5C

BIBLIOGRAPHIES

Ozone for Drinking Water Treatment: A Bibliography,
W87-09147 5F

BIG RIVER

Use of the Pocketbook Mussel, Lampsilis ventricosa, for Monitoring Heavy Metal Pollution in an Ozark Stream,
W87-08875 5A

BIOACCUMULATION

Usefulness of the Lipid Index for Bioaccumulation Studies with Daphnia magna,
W87-08652 5C

Chlorinated Insecticides and PCBs in Asteroidea and Holothuroidea Species from Rijeka Bay, Yugoslavia,
W87-08724 5B

Effect of Fertilization with Municipal Sludge on the Glutathione, Polyamine, and Cadmium Content of Cole Crops and Associated Loopers (Trichoplusia ni),
W87-08835 5C

Effect of Ingested Benzo(a)pyrene and Cadmium on Tissue Accumulation, Hydroxylase Activity, and Intestinal Morphology of the Black Sea Bass, Centropristis striata,
W87-08842 5C

Limits of Bioaccumulation of Organic Pigments in Fish: Their Relation to the Partition Coefficient and the Solubility in Water and Octanol,
W87-08853 5B

Comparative Kinetics for Bioaccumulation of Polychlorinated Biphenyls by the Polychaete (Capitella capitata) and Fish (Mugil cephalus),
W87-08856 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: I. Metabolism in the Euryhaline Fish, Oryzias latipes and Mugil cephalus,
W87-08859 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: II. Metabolism in the Freshwater Snails, Cipangopaludina japonica and Physa acuta,
W87-08860 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: III. Metabolism in the Crustaceans, Daphnia pulex and Palaemon paucidens,
W87-08861 5B

Organochlorine Pesticide Residues in Fish from the Shatt al-Arab River, Iraq,
W87-08880 5B

Cadmium Contamination in American Lobster, Homarus americanus, Near a Coastal Lead Smelter: Use of Multiple Linear Regression for Management,
W87-08882 5C

Cadmium and Lead in Lake Ontario Salmonids,
W87-08883 2H

Statistical Assessment of a Sampling Pattern for Evaluation of Changes in Mercury and Zinc Concentrations in Patella coerulea,
W87-08884 5A

Metal-Binding Protein in the Pacific Oyster, Crassostrea gigas: Assessment of the Protein as a Biochemical Environmental Indicator,
W87-08885 5A

Hexavalent Chromium Effects on Carbon Assimilation in Selenastrum capricornutum,
W87-08886 5C

Contamination of Fish from the French Zone of Lake Leman by Organochlorine Compounds between 1973 and 1981 (Contamination des Poissons du Secteur Francais du Lac Leman, par les Composes Organochlores entre 1973 et 1981),
W87-08909 2H

Residues of Organochlorine Pesticides in Environmental Samples from the Shatt-al-Arab River, Iraq,
W87-08910 5B

Fate of 14C-Lindane in a Rice-Fish Model Ecosystem,
W87-08915 5B

Residues of Organochlorine Chemicals and Concentrations of Heavy Metals in Ciconiforme Eggs in Relation to Diet and Habitat,
W87-08916 5B

Trace and Nutrient Element Transfer from Sewage Sludge-Amended Soil to Crops: A Study on Brassica oleracea,
W87-08917 5B

Residual Effects of Sewage Sludge on Soybean: I. Accumulation of Heavy Metals,
W87-08921 5C

Residual Effects of Sewage Sludge on Soybean: II. Accumulation of Soil and Symbiotically Fixed Nitrogen,
W87-08922 5C

Ammonium Bicarbonate-DTPA and DTPA Extractions of Sludge-Amended Soils,
W87-08923 5A

Effects of Cd(2+) and EDTA on Young Sugar Beets (Beta vulgaris). II. Net Uptake and Distribution of Mg(2+), Ca(2+), and Fe(2+)/Fe(3+),
W87-09228 2I

New Method for Determining the Concentrations of Volatile Organic Compounds in Sediment Interstitial Water,
W87-09233 5A

Disposition of Low and High Environmental Concentrations of PCBs in Snapping Turtle Tissues,
W87-09234 5B

Bioaccumulation Potential of Heterotrophic Bacteria for Lead, Selenium, and Arsenic,
W87-09240 5B

Zinc, Iron, Manganese, and Magnesium Accumulation in Crayfish Populations Near Copper - Nickel Smelters at Sudbury, Ontario, Canada,
W87-09243 5C

Zinc, Copper and Nickel Concentrations in Soil Extracts and Crops Grown on Four Soils Treated with Metal-loaded Sewage Sludges,
W87-09244 5B

Kinetic Models for Predicting Bioaccumulation of Pollutants in Ecosystems,
W87-09247 5B

Investigation into the Retention of 65Zn Absorbed by the Trophic Pathway in Cyprinus Carpio L. Influence of the Ingestion Frequency and the Radiozinc Content of Food (Etude de la Retention Du 65Zn Absorbe par voie Trophique Chez Cyprinus Carpio L. Influence du Rythme D'Ingestion et de la Teneur en Radiozinc de la Nourriture),
W87-09268 5B

Enhanced Uptake of Phosphorus by Activated Sludge - Effect of Substrate Addition,
W87-09270 5D

Bioaccumulation,
W87-09296 5B

Heavy Metal Concentrations in the Liver of Three Duck Species: Influence of Species and Sex,
W87-09380 5B

BIOASSAY

Carcinogenic Effects in A/J Mice of Particulate of a Coal Tar Paint Used in Potable Water Systems,
W87-08613 5C

Biological Effects of Continuous and Intermittent Dosing of Outdoor Experimental Streams with Chloropyrifos,
W87-08634 5C

Time/Toxicity Relationships in Short-Term Static, Dynamic, and Plug-Flow Bioassays,
W87-08639 5C

Rapid Aquatic Toxicity Assay Using Incorporation of Tritiated-Thymidine into Sea Urchin, Arbacia punctulata, Embryo: Evaluation of Toxicant Exposure Procedures,
W87-08655 5C

Xenobiotic-Metabolizing Enzyme Systems in Test Fish: I. Comparative Studies of Liver Microsomal Monooxygenases,
W87-08852 5C

Hexavalent Chromium Effects on Carbon Assimilation in Selenastrum capricornutum,
W87-08886 5C

Correlation between Heavy Metal Acute Toxicity Values in Daphnia magna and Fish,
W87-08887 5A

Factors Influencing Acute Toxicity of Coal Ash to Rainbow Trout (Salmo gairdneri) and Bluegill Sunfish (Lepomis macrochirus),
W87-08978 5C

Freshly Prepared Rat Hepatocytes Used in Screening the Toxicity of Blue-Green Algal Blooms,
W87-09230 5A

Toxic Effects of Organic Solvents on the Growth of Blue-Green Algae,
W87-09236 5C

Comparison of Toxicity Tests Conducted in the Laboratory and in Experimental Ponds using Cadmium and the Fathead Minnow (Pimephales promelas),
W87-09272 5C

Absence of Mutagenic and Antimutagenic Activities of Fluoride in Ames Salmonella Assays,
W87-09405 5C

BIOCHEMICAL ANALYSIS
Biochemistry/Physiology,
W87-09289 5C

BIOCHEMICAL OXIDATION
Downward Movement of Partly Degraded Materials in Dyked Marsh Soils,
W87-08998 2H

BIOCHEMICAL OXYGEN DEMAND
Laboratory and Instream Nitrification Rates for Selected Streams,
W87-09378 2H

BIOCIDES
Biocidal Control of Legionellae,
W87-08904 5F

BIOCONTROL
Biological Control of Aquatic Weeds: The Efficacy of Hybrid Grass Carp in Two Southern California Irrigation Canals,
W87-09480 4A

BIODEGRADATION
Biodegradation,
W87-08680 5B

Biodegradation of Phenols in an Integrated Activated Carbon Bed and Suspended Aerobic Biological Growth Reactor,
W87-08774 5D

Digestion of Carbohydrates and Protein by Gammarus mucronatus Say (Amphipoda),
W87-08839 2L

Growth of Mixed Microbial Populations in Ground Water Containing Highly Chlorinated Organic Wastes,
W87-08878 5B

Biodegradability of para-Dichlorobenzene and Its Behaviour in Model Activated Sludge Plants,
W87-09269 5D

Degradation of Aniline and Chloroanilines by Sunlight and Microbes in Estuarine Water,
W87-09271 5B

Biofilm Shearing Under Dynamic Conditions,
W87-09367 5D

Biodegradation of Trichloroethylene and Involvement of an Aromatic Biodegradative Pathway,
W87-09387 5D

BIODEGRATION
Biodegration of Chemically Dispersed Crude Oil,
W87-09512 5B

BIOFILM
Biofilm Shearing Under Dynamic Conditions,
W87-09367 5D

BIOINDICATORS
Heavy Metal Pollution in the Paraiba do Sul River, Brazil,
W87-08718 5B

Use of Bullfrogs (Rana catesbeiana) as Biological Markers for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin Contamination in the Environment,
W87-08733 5A

Trees as Indicators of Subterranean Water Flow from a Retired Radioactive Waste Disposal Site,
W87-08845 5A

Influence of Cadmium Exposure on Selected Hematological Parameters in Freshwater Teleost, Notemigonus crysoleucas,
W87-08857 5C

Comparative Metabolism of Fenitrothion in Aquatic Organisms: I. Metabolism in the Euryhaline Fish, Oryzias latipes and Mugil cephalus,
W87-08859 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: II. Metabolism in the Freshwater Snails, Cipangopaludina japonica and Physa acuta,
W87-08860 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: III. Metabolism in the Crustaceans, Daphnia pulex and Palaemon paucidens,
W87-08861 5B

Use of the Pocketbook Mussel, Lampsilis ventricosa, for Monitoring Heavy Metal Pollution in an Ozark Stream,
W87-08875 5A

Metal-Binding Protein in the Pacific Oyster, Crassostrea gigas: Assessment of the Protein as a Biochemical Environmental Indicator,
W87-08885 5A

Hexavalent Chromium Effects on Carbon Assimilation in Selenastrum capricornutum,
W87-08886 5C

Correlation between Heavy Metal Acute Toxicity Values in Daphnia magna and Fish,
W87-08887 5A

Impact-Sensitiveness of Soil Oribatid Species to the Waste Water from a Coal Distillation Plant,
W87-08898 5A

Lichens as Monitors of Atmospheric Deposition,
W87-09181 5C

Use of Bog Vegetation as a Monitor of Atmospheric Input of Metals,
W87-09182 5C

Freshly Prepared Rat Hepatocytes Used in Screening the Toxicity of Blue-Green Algal Blooms,
W87-09230 5A

Disposition of Low and High Environmental Concentrations of PCBs in Snapping Turtle Tissues,
W87-09234 5B

Role of Electrofishing in Assessing Environmental Quality of the Wabash River,
W87-09328 5A

BIOLOGICAL CONTROL
Comparative Study on the Intrinsic Rates of Increase of Cyrtobagous singularis and C. salviniae on the Water Weed Salvinia molesta,
W87-09217 4A

BIOLOGICAL MAGNIFICATION
Bioconcentration of Four Chlorinated Dioxins by Rainbow Trout and Fathead Minnows,
W87-08659 5B

Limits of Bioaccumulation of Organic Pigments in Fish: Their Relation to the Partition Coefficient and the Solubility in Water and Octanol,
W87-08853 5B

Comparative Kinetics for Bioaccumulation of Polychlorinated Biphenyls by the Polychaete (Capitella capitata) and Fish (Mugil cephalus),
W87-08856 5B

BIOLOGICAL OXYGEN DEMAND
Modelling of BOD-DO Dynamics in an Ice-Covered River in Northern China,
W87-09262 5B

BIOLOGICAL PROPERTIES
Regulation of Riverine Fish Communities by a Continuum of Abiotic-Biotic Factors,
W87-09037 2H

BIOLOGICAL TREATMENT
Biological Drinking Water Treatment Systems Involving Ozone,
W87-09144 5F

BIOLOGICAL WASTEWATER TREATMENT
Studies on Water Hyacinth as a Biological Filtre for Treating Contaminants from Agricultural Wastes and Industrial Effluents,
W87-08609 5D

Biodegradation of Phenols in an Integrated Activated Carbon Bed and Suspended Aerobic Biological Growth Reactor,
W87-08774 5D

Applications of Porous Membranes for Biomass Retention in Biological Wastewater Treatment Processes,
W87-08889 5D

Anaerobic Treatment of Distillery Slops Using an Upflow Anaerobic Filter Reactor,
W87-08890 5D

Biological Denitrification of a Highly Nitrogenous Industrial Effluent: A Case Study in Zimbabwe,
W87-08964 5D

Enhanced Uptake of Phosphorus by Activated Sludge - Effect of Substrate Addition,
W87-09270 5D

BIOMASS
Production-Destruction Processes in Ecosystems of Grassy Marshes of the Amur River Region,
W87-08709 2H

Regulation of Submerged Aquatic Plant Distribution in a Uniform Area of a Weedbed,
W87-08836 2H

Sestonic Bacteria as a Food Source for Filtering Invertebrates in Two Southeastern Blackwater Rivers,
W87-08870 2H

Applications of Porous Membranes for Biomass Retention in Biological Wastewater Treatment Processes,
W87-08889 5D

BIOS PROJECT
BIOS Project - Frontier Oil Spill Countermeasures Research,
W87-09523 5G

BIOTIC ENVIRONMENT
Establishment of Biotic Communities Within a Newly Constructed Ash Settling Basin and Its Drainage System,
W87-09323 5E

BIOTRANSFORMATION
Long-Term Effects of Bleached Kraft Mill Effluents on Carbohydrate Metabolism and Hepatic Xenobiotic Biotransformation Enzymes in Fish,
W87-08854 5C

BIOTRANSFORMATION

Comparative Metabolism of Fenitrothion in Aquatic Organisms: I. Metabolism in the Euryhaline Fish, Oryzias latipes and Mugil cephalus,
W87-08859 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: II. Metabolism in the Freshwater Snails, Cipangopaludina japonica and Physa acuta,
W87-08860 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: III. Metabolism in the Crustaceans, Daphnia pulex and Palaemon paucidens,
W87-08861 5B

Dynamics of Nitrogen and Carbon in Soil during Papermill Sludge Decomposition,
W87-08891 5E

Biotransformation,
W87-09297 5B

BIOTURBATION

Sedimentation and Bioturbation in a Salt Marsh as Revealed by 210Pb, 137Cs, and 7Be Studies,
W87-08932 2L

BLACKWATER RIVERS

Sestonic Bacteria as a Food Source for Filtering Invertebrates in Two Southeastern Blackwater Rivers,
W87-08870 2H

BLEACHING WASTES

Formation of Toxaphene-Like Contaminants During Simulated Paper Pulp Bleaching,
W87-09093 5B

BLOCK ISLAND

Ecological Factors in the Selection of Representative Species for Thermal Effluent Demonstrations,
W87-09315 5C

BLOCK RATE PRICING

Alternative Demand Model Estimators for Block Rate Pricing,
W87-08984 6C

BLOOD

Influence of Cadmium Exposure on Selected Hematological Parameters in Freshwater Teleost, Notemigonus crysoleucas,
W87-08857 5C

BLUEGILLS

Factors Influencing Acute Toxicity of Coal Ash to Rainbow Trout (Salmo gairdneri) and Bluegill Sunfish (Lepomis macrochirus),
W87-08978 5C

BOGS

Vegetation of the Low-Shrub Bogs of Northern New Jersey and Adjacent New York: Ecosystems at Their Southern Limit,
W87-08715 2H

Hydrology, Water Chemistry and Ecological Relations in the Raised Mound of Cowles Bog,
W87-08837 2H

Use of Bog Vegetation as a Monitor of Atmospheric Input of Metals,
W87-09182 5C

Hydrogeological Aspects of Agricultural Drainage in Ireland,
W87-09203 2E

BOOMS

Burmah Agate - Chronology and Containment Operations,
W87-09519 5B

Meredosia Oil Terminal - The Illinois River Floods a Tank Farm,
W87-09531 5G

Unique Inland Oil Spill - Glenrock, Wyoming,
W87-09532 5G

Flow Around Spill Cleanup Devices,
W87-09561 5G

BORDEN LANDFILL

Simulation of the Borden Plume Using the Alternating Direction Galerkin Technique,
W87-09030 5B

BORON

Soybean Growth and Boron Distribution in a Sandy Soil Amended with Scrubber Sludge,
W87-08927 5C

BOTTLED WATER

Bottled Water: An Alternative Source of Safe Drinking Water,
W87-09118 5F

Regulatory Flexibility and Consumer Options Under the Safe Drinking Water Act,
W87-09131 5F

Structure and Regulation of the European Bottled Water Industry,
W87-09132 5F

Antibiotic-Resistant Pseudomonas in Bottled Drinking Water,
W87-09424 5F

BOTTOM CURRENTS

Dynamics of Bottom Currents in a Small Lake,
W87-08865 2H

BOTTOMFISH

Chemical Contaminants in Bottomfish,
W87-09035 5B

BOUSSINESQ EQUATION

Capillarity Correction for Free Surface Flow of Groundwater,
W87-09018 2F

BRAHMAPUTRA RIVER

Heavy Metals Distribution in the Sediments of Ganges and Brahmaputra Rivers,
W87-09204 5B

BRANCH

Computation of Unsteady Flows in the Alabama River,
W87-08980 2E

BRANTLEY DAM

History of the Carlsbad Basin, Southeastern New Mexico,
W87-09151 6G

Pecos Past: The Prehistory and History of the Brantley Project Locality,
W87-09155 6G

Prehistory of the Carlsbad Basin, Southeastern New Mexico,
W87-09156 6G

BRASSICA

Trace and Nutrient Element Transfer from Sewage Sludge-Amended Soil to Crops: A Study on Brassica oleracea,
W87-08917 5B

BREAKWATERS

Kahului Breakwater Stability Study, Kahului, Maui, Hawaii: Hydraulic Model Investigation,
W87-09488 8B

Detailed Project Report and Environmental Assessment: Section 111, Shores East of Diked Disposal Area, Lorain Harbor, Ohio:
W87-09491 6G

BRESTAN

Acute Toxicity of Brestan and Fentin Acetate on Some Freshwater Organisms,
W87-08876 5C

BRINES

Origin of Brine in the San Andres Formation, Evaporite Confining System, Texas Panhandle and Eastern New Mexico,
W87-09351 2F

BULKING SLUDGE

Movement of Oligotrophic Bacteria in Activated Sludge,
W87-08771 5D

BUTYLTIN COMPOUNDS

Adsorptive Behavior of Butyltin Compounds Under Simulated Estuarine Conditions,
W87-08730 5B

CABBAGE LOOPERS

Effect of Fertilization with Municipal Sludge on the Glutathione, Polyamine, and Cadmium Content of Cole Crops and Associated Loopers (Trichoplusia ni),
W87-08835 5C

CADMIUM

Comparison of Techniques for Evaluating the Effect of Cadmium on Pseudomas Fluorescens,
W87-08648 5C

Quantities of Cadmium, Lead, Mercury and Arsenic Entering the U.K. Environment from Human Activities,
W87-08728 5B

Heavy Metals in Lake Kinneret (Israel): II. Hydrogen Sulfide Dependent Precipitation of Copper, Cadmium, Lead and Zinc,
W87-08761 2H

Attenuation of Cd and Pb Solubility in Municipal Waste Incinerator Ash,
W87-08776 5E

Effect of Fertilization with Municipal Sludge on the Glutathione, Polyamine, and Cadmium Content of Cole Crops and Associated Loopers (Trichoplusia ni),
W87-08835 5C

Effect of Ingested Benzo(a)pyrene and Cadmium on Tissue Accumulation, Hydroxylase Activity, and Intestinal Morphology of the Black Sea Bass, Centropristis striata,
W87-08842 5C

Influence of Cadmium Exposure on Selected Hematological Parameters in Freshwater Teleost, Notemigonus crysoleucas,
W87-08857 5C

Cadmium Contamination in American Lobster, Homarus americanus, Near a Coastal Lead Smelter: Use of Multiple Linear Regression for Management,
W87-08882 5C

Cadmium and Lead in Lake Ontario Salmonids,
W87-08883 2H

Effects of Cd(2+) and EDTA on Young Sugar Beets (Beta vulgaris). II. Net Uptake and Distribution of Mg(2+), Ca(2+), and Fe(2+)/Fe(3+),
W87-09228 2I

Toxicity and Bioaccumulation of Cadmium in Experimental Cultures of Duckweed, Lemna polyrrhiza L.,
W87-09241 5C

Comparison of Toxicity Tests Conducted in the Laboratory and in Experimental Ponds using Cadmium and the Fathead Minnow (Pimephales promelas),
W87-09272 5C

CALCIUM CHLORIDE
Effects of pH and Soil Type on Concentrations of Zinc, Copper and Nickel Extracted by Calcium Chloride from Sewage Sludge-Treated Soils,
W87-08911 5B

CALIFORNIA
Water Quality Beneath Urban Runoff Water Management Basins,
W87-08967 2F

Foundation Treatment Using Pneumatically Applied Concrete,
W87-09158 8F

CAMEROON
1986 Lake Nyos Gas Disaster in Cameroon, West Africa,
W87-08780 2H

CANADA
Input of Biologically Available Phosphorus by Precipitation to Precambrian Lakes,
W87-09174 5B

CANAL CONSTRUCTION
Geotechnical Aspects of Corani Reservoir Enlargement,
W87-08794 8A

CANALS
Heavy Metal Pollution of the Mid-Canal of Kandy: An Environmental Case Study from Sri Lanka,
W87-08840 5C

CANCER
Possible Influence of the Components of the Soil and Lithosphere on the Development and Growth of Neoplasms,
W87-08693 2K

CANOPY
Interception Losses of Rainfall from Cashew Trees,
W87-08621 2I

Estimation of Canopy Reservoir Capacity and Oxygen-18 Fractionation in Throughfall in a Pine Forest,
W87-08814 2B

CANOPY TEMPERATURES
Use of Canopy Temperatures to Identify Water Conservation in Cotton Germplasm,
W87-08788 3F

CAPILLARITY EFFECTS
Capillarity Correction for Free Surface Flow of Groundwater,
W87-09018 2F

CAPPING
Development of a Simplified Column Test for Evaluation of Thickness of Capping Material Required to Isolate Contaminated Dredged Material,
W87-09091 5G

Evaluating Asphalt Cap Effectiveness at Superfund Site,
W87-09379 5E

CAPTURE ZONE
Reverse Pathline Calculation of Time-Related Capture Zones in Nonuniform Flow,
W87-08753 2F

CARBOFURAN
Effect of Irrigation on Persistent Toxicity of Insecticides Applied as Granules to Soil to Brown Plant Hopper and Rice Swarming Caterpillar,
W87-08897 5B

CARBOHYDRATES
Digestion of Carbohydrates and Protein by Gammarus mucronatus Say (Amphipoda),
W87-08839 2L

Long-Term Effects of Bleached Kraft Mill Effluents on Carbohydrate Metabolism and Hepatic Xenobiotic Biotransformation Enzymes in Fish,
W87-08854 5C

CARBON
Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulfur, Micronutrients,
W87-08689 2G

Hexavalent Chromium Effects on Carbon Assimilation in Selenastrum capricornutum,
W87-08886 5C

Dynamics of Nitrogen and Carbon in Soil during Papermill Sludge Decomposition,
W87-08891 5E

CARBON CYCLE
Role of Gas Exchange in the Inorganic Carbon, Oxygen, and 222Rn Budgets of the Amazon River,
W87-08871 2H

CARBON DIOXIDE
1986 Lake Nyos Gas Disaster in Cameroon, West Africa,
W87-08780 2H

CARBON FILTERS
Operational Variables and the Release of Colonized Granular Activated Carbon Particles in Drinking Water,
W87-08957 5F

CARBON ISOTOPES
Simultaneous Measurement of Primary Production by Whole-Lake and Bottle Radiocarbon Additions,
W87-08931 2H

CARBON RADIOISOTOPES
Carbon Isotope Fractionation and Changes in the Flux and Composition of Particulate Matter Resulting from Biological Activity during a Sediment Trap Experiment in Lake Greifen, Switzerland,
W87-08867 2H

CARCINOGENS
Carcinogenic Effects in A/J Mice of Particulate of a Coal Tar Paint Used in Potable Water Systems,
W87-08613 5C

Possible Influence of the Components of the Soil and Lithosphere on the Development and Growth of Neoplasms,
W87-08693 2K

Short-Term Effects of Polynuclear Aromatic Hydrocarbons on Sea-Surface Microlayer Phytoneuston,
W87-09238 5C

CARDIOVASCULAR DISEASES
Geochemistry, Soils and Cardiovascular Diseases,
W87-08692 2F

CARIES
Epidemiology of Dental Caries in Relation to Environmental Trace Elements,
W87-08694 5C

CARNON RIVER
Hydrological and Chemical Factors Controlling the Concentrations of Fe, Cu, Zn and As in a River System Contaminated by Acid Mine Drainage,
W87-09277 5B

CAROLINA BAYS
Carolina Bays on the Eastern Shore of Maryland: I. Soil Characterization and Classification,
W87-08999 2H

CARP
Biological Control of Aquatic Weeds: The Efficacy of Hybrid Grass Carp in Two Southern California Irrigation Canals,
W87-09480 4A

CASE STUDIES
Heavy Metal Pollution of the Mid-Canal of Kandy: An Environmental Case Study from Sri Lanka,
W87-08840 5C

Institutional Analysis in Community Decision-Making: A Case Example from Southern Arizona,
W87-08981 6A

CASHEW TREES
Interception Losses of Rainfall from Cashew Trees,
W87-08621 2I

CASP
Canadian Atlantic Storms Program: The Meteorological Field Project,
W87-09255 2B

CATCHMENT AREAS
Groundwater Recharge and Discharge Response to Rainfall on a Hillslope,
W87-08706 2F

Linear Regression Model Combined with a Soil Water Balance Model to Design Micro-Catchments for Water Harvesting in Arid Zones,
W87-08738 3B

Proposals for Agricultural Development of Wadi Dhuleil Catchment, Jordan,
W87-08739 3F

Runoff Studies in a Small Catchment,
W87-08822 2E

Spatial Variability in the Chemical Composition of Snowcover in a Small, Remote, Scottish Catchment,
W87-08945 5B

Geochemical Studies in the Drainage Basin of the Rio Vouga, Portugal. IV. Impact of Land Use on the Hydrogeochemistry of Natural Waters in the Vouzela Region,
W87-09207 4C

CATCHMENT BASINS
Catchment Effects on the Horizontal Distribution of Phytoplankton in Five of Scotland's Largest Freshwater Lochs,
W87-08790 2H

CATFISH
Lead Nitrate Induced Changes in the Thyroid Physiology of the Catfish Clarias batrachus (L),
W87-08850 5C

Impact of Pesticides on Lipid Metabolism in the Freshwater Catfish, Clarias batrachus, during the Vitellogenic Phase of Its Annual Reproductive Cycle,
W87-08851 5C

Pesticide-Induced Changes in Peripheral Thyroid Hormone Levels during Different Reproductive Phases in Heteropneustes fossilis,
W87-08858 5C

CATIONS
Determination of Low Levels of Cationic Polyelectrolytes in Water,
W87-08986 5A

CATIONS

Removal of Multivalent Metal Cations from Water Using Micellular-Enhanced Ultrafiltration,
W87-09223 2K

CATTLE
Economics of the Treatment of Dairy Cow Slurry by Anaerobic Digestion,
W87-09216 5D

CAVITATION
Wastewater Treatment System Applying Aeration-Cavitation Flotation Mechanism,
W87-08603 5D

CELLULOSE
Scale-Up Experience with the Waterloo SCP Process in Industrial Biomass Waste Treatment,
W87-09455 5D

CEMENTS
Development Programs in the United States of America for the Application of Cement-Based Grouts in Radioactive Waste Management,
W87-09113 5E

High Pressure Grouting in Deep Gold Mines,
W87-09592 4B

Special Techniques of Ground Treatment in Mining Works (Las Tecnicas Especiales de Tratamiento del Terreno en los Trabajos de Mineria),
W87-09598 4B

CENTRIFUGATION
Concentration of Giardia Cysts from Water by a Centrifugal Cream Separator,
W87-09209 5A

Scale-Up of Solid Bowl Centrifuges for Sludge Dewatering,
W87-09445 5E

CERIODAPHNIA
Appropriate Durations and Measures for Ceriodaphnia Toxicity Tests,
W87-08654 5C

CESIUM
90Sr and 137Cs in Peat Deposits of Low-Lying Bog in the Influence Zone of the Beloyarsk Atomic Power Station,
W87-08710 5B

CHANNEL FLOW
Fluvial Hydrology,
W87-08685 2A

River Flow with Excessive Suspended Sediment Load: An Evaluation of Turbulent Flow Characteristics,
W87-08826 2E

Lateral Mixing in Channels Due to Secondary Currents,
W87-08827 2E

Use of Topological Information in Hydrograph Estimation,
W87-08976 2E

Turbulence Statistics in Fully Developed Channel Flow at Low Reynolds Number,
W87-09383 8B

CHANNEL IMPROVEMENT
Man-Induced Gradient Adjustment of the South Fork Forked Deer River, West Tennessee,
W87-09206 6G

CHANNEL MIGRATION
Shifting of the Kosi River, Northern India,
W87-08834 2E

CHANNEL MORPHOLOGY
Analysis of Horizontally Two-Dimensional Morphological Evolutions in Shallow Water,
W87-08782 7C

CHANNEL SHIFTING
Shifting of the Kosi River, Northern India,
W87-08834 2E

CHANNELING
Adverse Effects of Channelization and Their Amelioration,
W87-09043 6G

Man-Induced Gradient Adjustment of the South Fork Forked Deer River, West Tennessee,
W87-09206 6G

Development of a New Type of Fluidized Bed Reactor,
W87-09444 5D

Manual of Stream Channelization Impacts on Fish and Wildlife,
W87-09497 6G

CHANNELS
Lateral Mixing in Channels Due to Secondary Currents,
W87-08827 2E

CHELATING AGENTS
Determination of Cobalt, Copper, Mercury, and Nickel as Bis(2-hydroxyethyl)dithiocarbamate Complexes by High-Performance Liquid Chromatography,
W87-08831 5A

CHELATION
Determination of Cobalt, Copper, Mercury, and Nickel as Bis(2-hydroxyethyl)dithiocarbamate Complexes by High-Performance Liquid Chromatography,
W87-08831 5A

Metal-Binding Protein in the Pacific Oyster, Crassostrea gigas: Assessment of the Protein as a Biochemical Environmental Indicator,
W87-08885 5A

CHEMICAL ANALYSIS
Determination of Cobalt, Copper, Mercury, and Nickel as Bis(2-hydroxyethyl)dithiocarbamate Complexes by High-Performance Liquid Chromatography,
W87-08831 5A

Determination of Trace Metals in a River Water Reference Material by Inductively Coupled Plasma Mass Spectrometry,
W87-08832 5A

Spectrophotometric Determination of Traces of Silicon in Water after Collection as Silicomolybdenum Blue on an Organic-Solvent-Soluble Membrane Filter,
W87-08833 5A

Complete HF Digestion Method for Element and Trace Element Determination in Soils, Sediments, Sludges and Other Similar Samples Using a Closed System (HF-Totalaufschluss im geschlossenen System fur Element- und Spurenelementbestimmungen in Boden, Klarschlamm, Sedimenten u. a. Proben),
W87-08894 5A

Analysis of Pentachlorophenol in Water and Urine by Enrichment with Lipidex(R) 5000,
W87-08896 5A

Spatial Variability in the Chemical Composition of Snowcover in a Small, Remote, Scottish Catchment,
W87-08945 5B

Ecology of Estuaries, Volume I: Physical and Chemical aspects,
W87-09066 2H

Humic Substances in Groundwater,
W87-09070 2F

Extraction of Humic Substances from Soil,
W87-09079 7B

Isolation and Concentration Techniques for Aquatic Humic Substances,
W87-09080 2H

Fractionation of Soil Humic Substances,
W87-09081 2G

Analytical Methodology for Elemental Analysis of Humic Substances,
W87-09083 7B

Implications of Elemental Characteristics of Humic Substances,
W87-09084 7B

Molecular Size and Weight Measurements of Humic Substances,
W87-09085 7B

Acidic Functional Groups of Humic Substances,
W87-09086 2K

Spectroscopic Methods (Other Than NMR) for Determining Functionality in Humic Substances,
W87-09087 7B

Application of Nuclear Magnetic Resonance Spectroscopy for Determining Functionality in Humic Substances,
W87-09088 7B

Chemistry of Natural Waters,
W87-09149 2K

Sampling and Composition of the Surface Microlayer,
W87-09173 5A

Analytical Chemistry,
W87-09295 5B

Principles of Aquatic Chemistry,
W87-09305 2K

Simultaneous Determination of Linear Alkylbenzenesulfonates, Alkylphenol Polyethoxylates, and Nonylphenol by High-Performance Liquid Chromatography,
W87-09343 5A

Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants, Part 1,
W87-09462 5B

Polycyclic Aromatic Hydrocarbons in Oysters (Crassostrea Virginica) from Georgia Coastal Waters, Analyzed by High-Pressure Liquid Chromatography,
W87-09542 5A

CHEMICAL COMPOSITION
Geochemical Studies in the Drainage Basin of the Rio Vouga, Portugal. IV. Impact of Land Use on the Hydrogeochemistry of Natural Waters in the Vouzela Region,
W87-09207 4C

Toxicity of Chemical Mixtures,
W87-09286 5C

CHEMICAL POLLUTANTS
Behavior,
W87-09288 5C

Chemical Safety Evaluation,
W87-09301 5B

CHEMICAL PROPERTIES
Physical/Chemical Properties of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin,
W87-08657 5B

Environmental Exposure from Chemicals.
W87-08675 5B

Equilibrium Models for the Initial Integration of Physical and Chemical Properties,
W87-08683 5B

Prediction of the Occurrence of Four Species of Mosquito Larvae with Logistic Regression on Water-Chemistry Variables,
W87-08846 2H

Free Amino Acids in Lakes: Concentrations and Assimilation Rates in Relation to Phytoplankton and Bacterial Production,
W87-08868 2H

Role of Gas Exchange in the Inorganic Carbon, Oxygen, and 222Rn Budgets of the Amazon River,
W87-08871 2H

Principles of Aquatic Chemistry,
W87-09305 2K

Petroleum Spills in the Marine Environment: The Chemistry and Formation of Water-in-Oil Emulsions and Tar Balls,
W87-09339 5B

Aquatic Chemistry: An Introduction Emphasizing Chemical Equilibria in Natural Waters,
W87-09340 2A

CHEMICAL REACTIONS

Hydrolysis,
W87-08681 5B

Photochemical Transformations,
W87-08682 5B

Role of Cupric Ions in the Generation of Superoxide in Natural Waters,
W87-08716 2K

Stagnant Sulphidic Basin Waters,
W87-08722 2K

Adsorptive Behavior of Butyltin Compounds Under Simulated Estuarine Conditions,
W87-08730 5B

Extraction of Humic Substances from Soil,
W87-09079 7B

Chemical Changes of Organic Compounds in Chlorinated Water: XII. Gas Chromatographic-Mass Spectrometric Studies of the Reactions of Methylnaphthalenes with Hypochlorite in Dilute Aqueous Solution,
W87-09224 2K

Quantification of PCB by Dechlorination to Biphenyl,
W87-09259 5A

Gas-Chromatographic Determination of Total Polychlorinated Aromates and Chloro-Paraffins Following Catalytic Reduction in the Injection Port,
W87-09260 5A

On-Line Sulphate Monitoring by Reversed Flow Injection Analysis and Alternating Reagent Injection,
W87-09261 5A

Origin of Brine in the San Andres Formation, Evaporite Confining System, Texas Panhandle and Eastern New Mexico,
W87-09351 2F

CHEMICAL TREATMENT

Overview of Point-of-Use Water Treatment Technology,
W87-09119 5F

Effective Alternative to Official Regulation of Indirect Additives to Drinking Water,
W87-09120 5F

Oil Spill Cleanup with Dispersants: A Boomed Oil Spill Experiment,
W87-09535 5G

CHEMICALS

Multispecies Tests: Research Needs to Assess the Effects of Chemicals on Aquatic Life,
W87-08632 5A

CHEMISTRY

Principles of Aquatic Chemistry,
W87-09305 2K

CHEMISTRY OF PRECIPITATION

Spatial Variability in the Chemical Composition of Snowcover in a Small, Remote, Scottish Catchment,
W87-08945 5B

Seasonal and Spatial Trends in South Greenland Snow Chemistry,
W87-08946 5B

Free Amino Acids in Marine Rains: Evidence for Oxidation and Potential Role in Nitrogen Cycling,
W87-09349 2B

CHESAPEAKE BAY

Power-Plant-Related Estuarine Zooplankton Studies,
W87-09316 5C

Low Freshwater Inflow Study: Chesapeake Bay Hydraulic Model Investigation,
W87-09484 2L

CHIEF JOSEPH DAM

Post-Pool Raise Spillway Prototype Test for Chief Joseph Dam Columbia River, Washington,
W87-09153 8A

CHINA

Quantitative and Qualitative Aspects of Fish Crop in Relation to Environmental Quality,
W87-08855 5C

Future Trends in Hydropower Development in China,
W87-09407 8A

Exploitation and Control of Karst Water in Coal Measures,
W87-09575 2F

CHIRONOMID LARVAE

Enhancement of Inorganic Nitrogen and Phosphate Release from Lake Sediment by Tubificid Worms and Chironomid Larvae,
W87-09404 2H

CHLORINATED DIOXINS

Bioconcentration of Four Chlorinated Dioxins by Rainbow Trout and Fathead Minnows,
W87-08659 5B

CHLORINATED HYDROCARBONS

Growth of Mixed Microbial Populations in Ground Water Containing Highly Chlorinated Organic Wastes,
W87-08878 5B

Effects of Lowered Dissolved Oxygen Concentration on the Toxicity of 1,2,4-Trichlorobenzene to Fathead Minnows,
W87-08879 5C

Research in Environmental Pollution: II. Determination of Polychlorinated Nitrobenzenes (PCNB's) in Main River Fish,
W87-08895 5A

Contamination of Fish from the French Zone of Lake Leman by Organochlorine Compounds between 1973 and 1981 (Contamination des Poissons du Secteur Francais du Lac Leman, par les Composes Organochlores entre 1973 et 1981),
W87-08909 2H

CHLORINATED INSECTICIDES

Chlorinated Insecticides and PCBs in Asteroidea and Holothuroidea Species from Rijeka Bay, Yugoslavia,
W87-08724 5B

CHLORINATION

Handbook of Chlorination,
W87-09064 5D

Formation of Toxaphene-Like Contaminants During Simulated Paper Pulp Bleaching,
W87-09093 5B

Disinfectant Chemistry In Drinking Water - Overview of Impacts on Drinking Water Quality,
W87-09122 5F

By-Products of Chlorination: Specific Compounds and Their Relationship to Total Organic Halogen,
W87-09123 5F

Chemical Changes of Organic Compounds in Chlorinated Water: XII. Gas Chromatographic-Mass Spectrometric Studies of the Reactions of Methylnaphthalenes with Hypochlorite in Dilute Aqueous Solution,
W87-09224 2K

Modeling Coliform Bacteria Subject to Chlorination,
W87-09375 5D

CHLORINE

Acute Toxicity of Chlorine on Freshwater Organisms: Time-Concentration Relationships of Constant and Intermittent Exposures,
W87-08640 5C

By-Products of Chlorination: Specific Compounds and Their Relationship to Total Organic Halogen,
W87-09123 5F

CHLOROPHYLL A

Influence of Light on Chlorophyll, a Content of Blue-Green Algae Treated with Heavy Metals,
W87-09242 5C

CHLORPYRIFOS

Biological Effects of Continuous and Intermittent Dosing of Outdoor Experimental Streams with Chloropyrifos,
W87-08634 5C

CHROMATOGRAPHY

Isolation of Mutagenic Components by High-Performance Liquid Chromatography from XAD Extract of Water from the Nishitakase River, Kyoto City, Japan,
W87-08723 5A

Determination of Cobalt, Copper, Mercury, and Nickel as Bis(2-hydroxyethyl)dithiocarbamate Complexes by High-Performance Liquid Chromatography,
W87-08831 5A

Simultaneous Determination of Linear Alkylbenzenesulfonates, Alkylphenol Polyethoxylates, and Nonylphenol by High-Performance Liquid Chromatography,
W87-09343 5A

Polycyclic Aromatic Hydrocarbons in Oysters (Crassostrea Virginica) from Georgia Coastal Waters, Analyzed by High-Pressure Liquid Chromatography,
W87-09542 5A

CHROMIUM

Hexavalent Chromium Effects on Carbon Assimilation in Selenastrum capricornutum,
W87-08886 5C

CHRONIC TOXICITY
Chronic Toxicity Tests,
W87-09283 5C

CHRYSOPHYTA
Algal Phagotrophy: Regulating Factors and Importance Relative to Photosynthesis in Dinobryon (Chrysophyceae),
W87-08929 2H

CICER
Effects of Distillery Waste on the Performance of Cicer arietinum L.,
W87-08873 5C

CICONIFORME
Residues of Organochlorine Chemicals and Concentrations of Heavy Metals in Ciconiforme Eggs in Relation to Diet and Habitat,
W87-08916 5B

CINNABAR
Mercury Pollution in Marine Sediment Cores Near Cinnabar Deposits and a Chlor-Alkali Plant,
W87-08727 5B

CLADOCERA
Ecological and Physiological Differentiation Among Low-Arctic Clones of Daphnia Pulex,
W87-08691 2H

CLAMS
Use of Asiatic Clam Larvae in Aquatic Hazard Evaluations,
W87-09326 5C

CLARIFIERS
Sediment Diffusion in Primary Shallow Rectangular Clarifiers,
W87-09376 5F

CLAY
Reduction in Hydraulic Conductivity in Relation to Clay Dispersion and Disaggregation,
W87-08996 2G

Desorption and Regeneration of Dye Colours from Low-Cost Materials,
W87-09279 5D

CLEAN WATER ACT
Clean Water Act Update: A New Role for Toxicology,
W87-08627 6E

CLEANUP OPERATIONS
Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup).
W87-09507 5B

Evaluation of Oil Spill Dispersant Testing Requirements,
W87-09508 5G

Onshore Impacts and Cleanup During the Burmah Agate Oil Spill - November 1979,
W87-09518 5C

Burmah Agate - Chronology and Containment Operations,
W87-09519 5B

BIOS Project - Frontier Oil Spill Countermeasures Research,
W87-09523 5G

Dome Petroleum's Oil Spill Research and Development Program for the Arctic,
W87-09524 5G

Containment of Oil Spilled Under Rough Ice,
W87-09526 5B

Kurdistan - An Unusual Spill Successfully Handled,
W87-09527 5G

Wreck of the Lee Wang Zin,
W87-09528 5G

Cold Weather Response F/V Ryuyo Maru No. 2 St. Paul, Pribiloff Islands, Alaska,
W87-09529 5G

Coast Guard Environmental Mission Fulfilled by Naval Salvage, French Frigate Shoals,
W87-09530 5G

Meredosia Oil Terminal - The Illinois River Floods a Tank Farm,
W87-09531 5G

Unique Inland Oil Spill - Glenrock, Wyoming,
W87-09532 5G

Assessment of Aerial Application of Oil Spill Dispersants,
W87-09533 5G

Aerial Application of Dispersants at the Ixtoc I Spill,
W87-09534 5G

Oil Spill Cleanup with Dispersants: A Boomed Oil Spill Experiment,
W87-09535 5G

1979 Southern California Dispersant Treated Research Oil Spills,
W87-09536 5G

Fate and Effects of Dispersant-Treated Compared with Untreated Crude Oil, with Particular Reference to Sheltered Intertidal Sediments,
W87-09537 5G

Spill Impacts and Shoreline Cleanup Operations on Arctic and Sub-Arctic Coasts,
W87-09538 5G

Restoration of Oiled Marshes Through Sediment Stripping and Spartina Propagation,
W87-09546 5G

Effects of Oil Spill Cleanup Techniques on a Salt Marsh,
W87-09548 5C

Response to the Esso Bayway Oil Spill,
W87-09549 5G

Atlantic Empress Sinking - A Large Spill Without Environmental Disaster,
W87-09553 5C

Ixtoc I Oil Spill - The Damage Assessment Program and Ecological Impact,
W87-09554 5C

Development of a Flaring Burner Oil Disposal System,
W87-09560 5D

Flow Around Spill Cleanup Devices,
W87-09561 5G

Open Ocean Skimmer Performance Tests,
W87-09562 5G

Development and Testing of a Weir Boom for Oil Recovery at Sea,
W87-09563 5G

Experiences Gained From Deployment of Booms and Skimmers in Various Oil Recovery Applications,
W87-09564 5G

Coherent, Plunging Water Jets for Oil Spill Control,
W87-09565 5G

Design Aspects of the First 'Slicktrail' Dredger, The Cosmos,
W87-09566 5G

CLIMATE FORECASTING
Climate Forecast Verifications, U.S. Mainland, 1974-82,
W87-09499 2B

CLIMATES
Rainfall in the Wet-Dry Tropics: Extreme Events at Darwin and Similarities Between Years During the Period 1870-1983 Inclusive,
W87-08775 2B

CLIMATOLOGY
Data Intercomparison Theory I. Minimal Spanning Tree Tests for Location and Scale Differences,
W87-09501 7C

Data Intercomparison Theory V. Case Study: Effects of Objective Analysis on a Tropical Pacific Sea Surface Temperature Set,
W87-09502 7C

Data Intercomparison Theory IV. Tercile Tests for Location, Spread and Pattern Differences,
W87-09503 7C

Data Intercomparison Theory II. Trinity Statistics for Location, Spread and Pattern Differences,
W87-09504 7C

Data Intercomparison Theory III. S-Phase and T-Phase Tests for Spatial Pattern and Temporal Evolution,
W87-09505 7C

CLONES
Ecological and Physiological Differentiation Among Low-Arctic Clones of Daphnia Pulex,
W87-08691 2H

CLOSURE
Optimization of Closure Operations in a Tidal Basin During a Storm-Surge,
W87-08610 4A

CLOUD PHYSICS
Tracer Study of Vertical Exchange by Cumulus Clouds,
W87-08699 2A

CLOUD SEEDING
SCPP Meteorological and Statistical Support for Period 1 September 1985, 31 August 1986, Volume I: Interim Progress Report,
W87-09334 2B

CLOUD WATER
Two New Ground-Level Cloud Water Sampler Designs Which Reduce Rain Contamination,
W87-08948 7B

CLOUD WATER COLLECTORS
Two New Ground-Level Cloud Water Sampler Designs Which Reduce Rain Contamination,
W87-08948 7B

CLOUDS
Numerical Simulation of the Effects of Varying Ice Crystal Nucleation Rates and Aggregation Processes on Orographic Snowfall,
W87-08697 2B

Tracer Study of Vertical Exchange by Cumulus Clouds,
W87-08699 2A

Tropical Squall Line Observed During the COPT 81 Experiment in West Africa. Part I: Kinematic Structure Inferred from Dual-Doppler Radar Data,
W87-08939 2B

SO2 Oxidation in Cloud Drops Containing NaCl or Sea Salt as Condensation Nuclei,
W87-08950 6E

COAGULATION
Removal of Individual Off-Flavour Compounds in Water During Artificial Groundwater Recharge and During Treatment by Alum Coagulation/Sand Filtration,
W87-09267 5F

COAL
Managing Powerplant Combustion Wastes,
W87-08803 5E

COAL ASH
Factors Influencing Acute Toxicity of Coal Ash to Rainbow Trout (Salmo gairdneri) and Bluegill Sunfish (Lepomis macrochirus),
W87-08978 5C

COAL COMBUSTION WASTES
Managing Powerplant Combustion Wastes,
W87-08803 5E

COAL GASIFICATION
Water-Quality Monitoring at the Hoe Creek Test Site: Review and Preliminary Conclusions,
W87-09495 5B

COAL MINES
Mine Drainage Problems in Indian Coalfields, with Special Reference to the Problems in Jharia Coalfield,
W87-09571 4C

Exploitation and Control of Karst Water in Coal Measures,
W87-09575 2F

Hydrogeologic Factors that May Affect Mine Drainage in the Anthracite Region of Pennsylvania, Eastern United States,
W87-09577 4C

COAL MINING
Stream Water Quality in the Coal Region of Virginia,
W87-09494 4C

Role of Hydrogeology in Coal Mining Near Chandrapur in Maharashtra, India,
W87-09569 2F

Mine Drainage Problems in Indian Coalfields, with Special Reference to the Problems in Jharia Coalfield,
W87-09571 4C

Hydrogeology of Underground Coal Mines in Illinois,
W87-09573 2F

Development of a Ground Water Hazard Map for an Underground Coal Mine,
W87-09585 2F

Hydrogeological Aspects of Coal Mining Under Stored Waters Near Sydney, Australia,
W87-09587 2F

COAL MINING EFFECTS
Stream Water Quality in the Coal Region of Virginia,
W87-09494 4C

COAL TAR PAINTS
Carcinogenic Effects in A/J Mice of Particulate of a Coal Tar Paint Used in Potable Water Systems,
W87-08613 5C

COAL WASTES
Leaching Behaviors of Low-Sulfur Coals and Coal Wastes from Three Western Coal Preparation Plants,
W87-09429 5B

COASTAL ENGINEERING
Attempts to Determine the Viability of a Deep Excavation on the Coast of the Vandellos Massif (Tarragona, Spain) (Ensayos Para Determinar la Viabilidad de una Excavacion Profunda en el Litoral del Macizo de Vandellos (Tarragona, Expana)),
W87-09574 2F

COASTAL MARSHES
Impact of Oil on Marsh Communities in the St. Lawrence River,
W87-09541 5C

COASTAL PLAINS
Transport of Solids in Streamflow from Coastal Plain Watersheds,
W87-08924 2J

COASTAL WATERS
Geochemical Partitioning of Heavy Metals in Sediments of Three Estuaries Along the Coast of Rio de Janeiro (Brazil),
W87-08717 2L

Composition of Suspended Particulate Matter from Scottish Coastal Waters Geochemical Implications for the Transport of Trace Metal Contaminants,
W87-08729 5B

COBALT
Determination of Cobalt, Copper, Mercury, and Nickel as Bis(2-hydroxyethyl)dithiocarbamate Complexes by High-Performance Liquid Chromatography,
W87-08831 5A

COKE
Recovery of Organics from Tailings Pond Sludge Using Coke for Agglomeration,
W87-08602 5D

COLD FRONTS
Rainfall Pattern Associated with a Split Cold Front as Seen on FRONTIERS,
W87-08800 2B

COLD REGIONS
Cold Weather Response F/V Ryuyo Maru No. 2 St. Paul, Pribiloff Islands, Alaska,
W87-09529 5G

Spill Impacts and Shoreline Cleanup Operations on Arctic and Sub-Arctic Coasts,
W87-09538 5G

COLE RIVER
Ameliorative Methods to Reinstate Fisheries Following Land Drainage Operations,
W87-09048 6G

COLIFORMS
Bacteriological Quality of Drinks From Vending Machines,
W87-08704 5F

Modeling Coliform Bacteria Subject to Chlorination,
W87-09375 5D

COLOR REMOVAL
Removal of Color from Drinking Water with Ozone,
W87-09138 5F

COLORADO
Humic Substances in Groundwater,
W87-09070 2F

Dolores Archaeological Program: Anasazi Communities at Dolores: Early Anasazi Sites in the Sagehen Flats Area,
W87-09330 6G

COLORADO RIVER
Study of Saline Water Use at the Harry Allen Generating Station,
W87-09332 3C

COLUMBIA RIVER
Review of Effects of Environmental Degradation on the Freshwater Stages of Anadromous Fish,
W87-09042 2H

Post-Pool Raise Spillway Prototype Test for Chief Joseph Dam Columbia River, Washington,
W87-09153 8A

COMMENCEMENT BAY
Suspended Particulate Matter in Commencement Bay,
W87-09498 2J

COMMUNITIES
Water Resources Audit for Small Communities,
W87-08953 5F

COMPARISON STUDIES
2-D Elastoplastic Seismic Shear Response of Earth Dams: Applications,
W87-08608 8A

Interlaboratory Comparison of the ASTM Bioconcentration Test Method Using the Eastern Oyster,
W87-08645 5A

Comparison of Techniques for Evaluating the Effect of Cadmium on Pseudomas Fluorescens,
W87-08648 5C

Comparison of Field and Laboratory Methods for Determining Contaminant Flow Parameters,
W87-08757 5B

Analysis of Volume Change in Unconfined Units of Soil,
W87-08992 2G

Comparison of the Hydrophobic-Grid Membrane Filter Procedure and Standard Methods for Coliform Analysis of Water,
W87-09392 5A

Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XI. Growth of Geum rivale L. and Geum urbanum L. and Soil Chemical Condition in Experimentally Flooded Soil,
W87-09398 2I

Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XII. Growth, Photosynthetic Capacity and Metal Ion Uptake in Salix caprea and S. Cinerea ssp. Oleifolia,
W87-09399 2I

Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XIII. The Effect of Fe(2+) on Photosynthesis and Respiration of Salix caprea and S. cinerea ssp. oleifolia,
W87-09400 2I

Effect of Waterlogging on Infection of Eucalyptus marginata Seedlings by Phytophthora cinnamomi,
W87-09401 2I

COMPASS PLANT
Field Water Relations of a Compass Plant, Lactuca serriola L.,
W87-08772 2I

COMPETITION
Water Relations of Xeric Grasses in the Field: Interactions of Mycorrhizzas and Competition,
W87-09341 2I

COMPUTER MODELS
Example Model Applications,
W87-09105 4C

COMPUTER MODELS

Environmental Impact Analysis of Aquatic Ecosystems Using Rational Threshold Value Methodologies,
W87-09313 5C

Comprehensive Model for Oil Spill Simulation,
W87-09552 5B

COMPUTER PROGRAMS
Predictive Application of an ORNL Geohydrology Model,
W87-08760 7C

Sedimentation in Lake Onalaska, Navigation Pool 7, Upper Mississippi River, Since Impoundment,
W87-08969 2J

BASIC Hydraulics,
W87-09304 8B

BASIC Soil Mechanics,
W87-09307 8D

Focus: Fisheries Oceanography Cooperative Users System,
W87-09500 7C

COMPUTERS
BASIC Hydraulics,
W87-09304 8B

BASIC Soil Mechanics,
W87-09307 8D

CONCRETE
Foundation Treatment Using Pneumatically Applied Concrete,
W87-09158 8F

CONCRETE CONSTRUCTION
Concrete Dam of the Denin Dnepr Hydroelectric Station,
W87-09352 8A

Assignment of Strength Requirments of Concrete for Large Dams,
W87-09354 8F

CONCRETE DAMS
Concrete Dam of the Denin Dnepr Hydroelectric Station,
W87-09352 8A

CONCRETE TECHNOLOGY
Foundation Treatment Using Pneumatically Applied Concrete,
W87-09158 8F

Concrete Temperature Control During Dam Construction,
W87-09408 8F

Use of Silica-Fume Concrete to Repair a Stilling Basin,
W87-09413 8F

CONDENSATION
Recovery of Water from Atmospheric Air in Arid Climates,
W87-08601 5F

CONDENSATION NUCLEI
SO2 Oxidation in Cloud Drops Containing NaCl or Sea Salt as Condensation Nuclei,
W87-08950 6E

CONFERENCES
Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup).
W87-09507 5B

CONFINED AQUIFERS
Application of Isotope Techniques and Well Loggind in Investigating Ground Water Influenced by Mining,
W87-09580 2F

CONFORMAL-MAPPING TECHNIQUE
Conformal-Mapping Technique for Topographic-Wave Problems: Semi-Infinite Channels and Elongated Basins,
W87-09384 7C

CONIFEROUS FORESTS
Macrofossil and Pollen Representation of Coniferous Trees In Modern Sediments from Washington,
W87-08690 2H

Estimation of Canopy Reservoir Capacity and Oxygen-18 Fractionation in Throughfall in a Pine Forest,
W87-08814 2B

CONNECTICUT
Social and Economic Impacts of Selected Potential Dredged Material Containment Facilities in Long Island Sound.
W87-09471 6B

Dredged Material Containment in Long Island Sound (With Special Emphasis on Eastern New York Waters),
W87-09474 8A

CONNECTICUT RIVER
Spring and Summer Movements of Subadult Striped Bass, Morone saxatilis, in the Connecticut River,
W87-09253 2H

CONSCIENCE BAY
Physical and Chemical Behavior and Environmental Acceptability of Stabilized Scrubber Sludge and Fly Ash in Seawater,
W87-09327 5B

CONSERVATION
Agricultural Drainage Practices in Ireland,
W87-09202 4A

Wetlands Policy Crisis: United States and United Kingdom,
W87-09215 6E

CONSTRUCTION
Geotechnical Aspects of Corani Reservoir Enlargement,
W87-08794 8A

Concrete Dam of the Denin Dnepr Hydroelectric Station,
W87-09352 8A

CONSTRUCTION COSTS
Giant Water Tank Rises in Austin,
W87-08801 5F

Puerto Rico Seeks Clean Water,
W87-08802 5D

CONSUMPTIVE USE
Low Freshwater Inflow Study: Chesapeake Bay Hydraulic Model Investigation,
W87-09484 2L

CONTAMINATION
Contamination of Fish from the French Zone of Lake Leman by Organochlorine Compounds between 1973 and 1981 (Contamination des Poissons du Secteur Francais du Lac Leman, par les Composes Organochlores entre 1973 et 1981),
W87-08909 2H

Nonpoint Agricultural Pollution: Pesticide Contamination of Groundwater Supplies,
W87-09213 5B

CONVECTION
Tracer Study of Vertical Exchange by Cumulus Clouds,
W87-08699 2A

Consistent Parameterization of the Effects of Cumulus Clouds on the Large-Scale Momentum and Vorticity Fields,
W87-08938 2B

Tropical Squall Line Observed During the COPT 81 Experiment in West Africa. Part I: Kinematic Structure Inferred from Dual-Doppler Radar Data,
W87-08939 2B

Relationship of Low-Level Winds and Moisture to Convection in the Tropical Pacific,
W87-08941 2B

CONVECTIVE PRECIPITATION
Impact of Mesoscale Convective Systems on Regional Visibility and Oxidant Distributions during Persistent Elevated Pollution Episodes,
W87-08695 2B

COOLIDGE DAM
Coolidge Dam: Photographs Written Historical and Descriptive Data Reduced Copies of Drawings,
W87-09163 8A

COOLING RESERVOIRS
Thermal and Dissolved Oxygen Characteristics of a South Carolina Cooling Reservoir,
W87-08975 2H

COOLING WATER
Presence of Legionella in London's Water Supplies,
W87-08901 5F

Seasonality of Legionella Isolates from Environmental Sources,
W87-08902 2H

Biocidal Control of Legionellae,
W87-08904 5F

COPPER
Role of Cupric Ions in the Generation of Superoxide in Natural Waters,
W87-08716 2K

Seasonal Variation of Copper and Zinc Concentrations in the Oyster Saccostrea cuccullata from the Dampier Archipelago, Western Australia: Implications for Pollution Monitoring,
W87-08732 5B

Heavy Metals in Lake Kinneret (Israel): II. Hydrogen Sulfide Dependent Precipitation of Copper, Cadmium, Lead and Zinc,
W87-08761 2H

Determination of Cobalt, Copper, Mercury, and Nickel as Bis(2-hydroxyethyl)dithiocarbamate Complexes by High-Performance Liquid Chromatography,
W87-08831 5A

Effects of pH and Soil Type on Concentrations of Zinc, Copper and Nickel Extracted by Calcium Chloride from Sewage Sludge-Treated Soils,
W87-08911 5B

Copper in Marine Microlayers: Accumulation, Speciation and Transport,
W87-09172 5B

Effects of Copper on the Periphyton of a Small Calcareous Stream,
W87-09318 5C

Induction of Siderophore Activity in Anabaena spp. and Its Moderation of Copper Toxicity,
W87-09386 5G

COPPER-ORGANIC COMPLEXES
Chromatographic Studies of Dissolved Organic Matter and Copper-Organic Complexes Isolated From Estuarine Waters,
W87-08960 7B

COPRECIPITATION
Removal of Antimony from Aqueous Systems,
W87-08604 5F

CORANI RESERVOIR
Geotechnical Aspects of Corani Reservoir Enlargement,
W87-08794 8A

CORN
Estimating Water Table Contribution to the Water Supply of Maize,
W87-08740 3F

Effect of Tillage System on Runoff Losses of Surface-Applied Pesticides,
W87-09001 2E

Simulation Model for Predicting Effect of Water Stress on Yield: An Example Using Corn,
W87-09470 3F

COST ANALYSIS
Production Functions for Water Delivery Systems: Analysis and Estimation Using Dual Cost Function and Implicit Price Specifications,
W87-09014 6D

Small-Scale Hydroelectric Power.
W87-09110 6A

Economics of the Treatment of Dairy Cow Slurry by Anaerobic Digestion,
W87-09216 5D

Annual Macroinvertebrate Sampling - A Low-Cost Tool for Ecological Assessment of Effluent Impact,
W87-09325 5C

Optimal Water Treatment Plant Design,
W87-09374 5F

COST-BENEFIT ANALYSIS
Agricultural Drainage Practices in Ireland,
W87-09202 4A

COSTS
Giant Water Tank Rises in Austin,
W87-08801 5F

Puerto Rico Seeks Clean Water,
W87-08802 5D

COTTON
Use of Canopy Temperatures to Identify Water Conservation in Cotton Germplasm,
W87-08788 3F

COWLES BOG
Hydrology, Water Chemistry and Ecological Relations in the Raised Mound of Cowles Bog,
W87-08837 2H

CRAB BURROWS
Sedimentation and Bioturbation in a Salt Marsh as Revealed by 210Pb, 137Cs, and 7Be Studies,
W87-08932 2L

Distribution and Abundance of Helice tridens (De Haan) Burrows and Substratum Conditions in a Northeastern Japan Salt Marsh (Crustacea: Brachyura),
W87-08987 2L

CRACK PROPAGATION
Conditions for Crack Propagation by Frost Wedging,
W87-09350 2C

CRACKING
Concrete Temperature Control During Dam Construction,
W87-09408 8F

CRASSULACEAN ACID
Induction of Crassulacean Acid Metabolism in Mesembryanthemum crystallinum by High Salinity: Mass Increase and de Novo Synthesis of PEP-Carboxylase,
W87-09418 3C

CRAYFISH
Effects of Habitat Modification on Freshwater Crayfish,
W87-09062 4C

Zinc, Iron, Manganese, and Magnesium Accumulation in Crayfish Populations Near Copper - Nickel Smelters at Sudbury, Ontario, Canada,
W87-09243 5C

CREDIT
Innovative State Policies for Aiding Community Water Suppliers,
W87-08951 5F

CROP PRODUCTION
Irrigation Practice for Crop Culture in the Southeastern United States,
W87-09466 3F

CROP RESIDUE
Control of Furrow Erosion With Crop Residues and Surge Flow Irrigation,
W87-09003 3F

CROP YIELD
Water Production Functions for Wheat under Different Environmental Conditions,
W87-08748 3F

Model for Predicting the Influence of Moisture Stress on Crop Losses Caused by Ozone,
W87-08783 2I

Impact of Simulated Acidic Precipitation on Quantity and Quality of a Field Grown Potato Crop,
W87-08789 5C

Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: I. Persistence, Yield, Quality, and Elemental Removal,
W87-08919 5C

Simulation Model for Predicting Effect of Water Stress on Yield: An Example Using Corn,
W87-09470 3F

CROPS
Economic Differences Between Cumulative and Episodic Reduction of Sediment from Cropland,
W87-09090 2J

CROSS LAKE
Spatial Variability in Selected Physical Characteristics and Processes in Cross Lake, New York,
W87-08973 2H

CRUSTACEANS
Effects of Triethylene Glycol on Mysidopsis bahia (Crustacea: Mysidacea) and Menidia peninsulae (Pisces: Atherinidae),
W87-08644 5C

Trophic Interactions in the Plankton of Malyi Sevan in July, 1984,
W87-09219 2H

CRYPTOMONAS
Ecology of a Cryptomonas phaseolus Population Forming a Metalimnetic Bloom in Lake Ciso, Spain: Annual Distribution and Loss Factors,
W87-08930 2H

CUCUMBERS
Influence of Simulated Acidic Rain on Vegetative and Reproductive Tissues of Cucumber (Cucumis sativus L.),
W87-09232 5C

CULTIVATION EFFECTS
Downward Movement of Partly Degraded Materials in Dyked Marsh Soils,
W87-08998 2H

CULTURING MEDIA
Evaluation of the Multitest Medium for Rapid Presumptive Identification of Vibrio cholerae from Environmental Sources,
W87-09397 5A

CUMULUS CLOUDS
Consistent Parameterization of the Effects of Cumulus Clouds on the Large-Scale Momentum and Vorticity Fields,
W87-08938 2B

CUNNER
Feeding Reduction and Recovery in Cunner Tautogolabrus adspersus Following Exposure to Crude Oil,
W87-09239 5C

CURRANT CREEK
Effect of Beaver Ponds on the Nonpoint Source Water Quality of a Stream in Southwestern Wyoming,
W87-09265 2H

CURRENTS
Scanning Currents in Stokes Flow and the Efficient Feeding of Small Organisms,
W87-09385 2H

CYANOPHYTA
Freshly Prepared Rat Hepatocytes Used in Screening the Toxicity of Blue-Green Algal Blooms,
W87-09230 5A

Toxic Effects of Organic Solvents on the Growth of Blue-Green Algae,
W87-09236 5C

Influence of Light on Chlorophyll, a Content of Blue-Green Algae Treated with Heavy Metals,
W87-09242 5C

Systematics and Ecology of Lyngbya spp. and Associated Species (Cyanophyta) in a New England Salt Marsh,
W87-09423 2L

CYCLING NUTRIENTS
Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulfur, Micronutrients,
W87-08689 2G

Suppression of Phosphate Liberation from Sediment by Using Iron Slag,
W87-09273 5G

CYCLONE DOMOINA
Extreme Floods in Southern Africa Caused by Tropical Cyclone Domoina,
W87-09410 2F

DAIRY INDUSTRY
Economics of the Treatment of Dairy Cow Slurry by Anaerobic Digestion,
W87-09216 5D

DAM CONSTRUCTION
Arch Dam of the Khudoni Hydroelectric Station,
W87-09353 8A

Problems of Water Inrush into Greek Underground Mines with Special Emphasis to Sea Water Inrush Through Karstic Limestones or Impermeable Formations,
W87-09596 2F

DAM DESIGN
New Procedures for Flood Estimation in Norway,
W87-08811 2E

DAM EFFECTS
Drowning of a Culture,
W87-09231 6G

DAMS
New Procedures for Flood Estimation in Norway,
W87-08811 2E

Groundwater Modelling for Hydropower Development in Iceland,
W87-08829 2F

Embankment Dam Instrumentation Manual,
W87-09157 8A

Concrete Dam of the Denin Dnepr Hydroelectric Station,
W87-09352 8A

Assignment of Strength Requirments of Concrete for Large Dams,
W87-09354 8F

Considertion of the Stress-Strain State in Calculations of Slope Stability of Earth Dams,
W87-09356 8D

Detection of Defects in a Grout Curtain by Geophysical Methods,
W87-09358 8E

Roman Dams in Southern Portugal,
W87-09411 6E

Sri Lanka's Randenigala Project,
W87-09412 8A

Overtopping Risk for an Existing Dam,
W87-09461 8A

DAMSITES
Predicting Settlement at a Damsite on a Tunnel Valley Deposit in Alberta,
W87-08795 8A

DANUBE RIVER
Effects on Fisheries of Non-Biotic Modifications of the Environment in the East-Danube River Area,
W87-09038 6G

DAPHNIA
Brood Size and Neonate Weight of Daphnia magna Produced by Nine Diets,
W87-08641 2H

Sensitivity of Chronic Endpoints Used in Daphnia Magna Straus Life-Cycle Tests,
W87-08642 5C

Usefulness of the Lipid Index for Bioaccumulation Studies with Daphnia magna,
W87-08652 5C

Ecological and Physiological Differentiation Among Low-Arctic Clones of Daphnia Pulex,
W87-08691 2H

Correlation between Heavy Metal Acute Toxicity Values in Daphnia magna and Fish,
W87-08887 5A

Comparative Toxicity of SRC-I Wastewater to Aquatic Organisms,
W87-09106 5C

DARWIN
Rainfall in the Wet-Dry Tropics: Extreme Events at Darwin and Similarities Between Years During the Period 1870-1983 Inclusive,
W87-08775 2B

DATA ACQUISITION
Measuring Fish Lengths from Instant Photographs Using a Digitizing Tablet and Minicomputer,
W87-08649 7B

Measurement of Soil Water Content Using the Combined Time-Domain Reflectometry - Thermal Conductivity Probe,
W87-08796 2G

Remote Sensing: Principles and Interpretation,
W87-09065 7B

DATA AQUISITION
On-Site Observations of the State of Structures at the Kanev Lock,
W87-09363 7A

DATA BASES
Focus: Fisheries Oceanography Cooperative Users System,
W87-09500 7C

DATA COLLECTIONS
Rainfall in the Wet-Dry Tropics: Extreme Events at Darwin and Similarities Between Years During the Period 1870-1983 Inclusive,
W87-08775 2B

Low Discharge Periods of Rivers in the Upper Vistula River Basin, Poland,
W87-08970 7B

Estimating Baseflow Volume and its Uncertainty,
W87-08971 2E

DATA INTERPRETATION
Generalized Method of Moments as Applied to Problems of Flood Frequency Analysis: Some Practical Results for the Log-Pearson Type 3 Distribution,
W87-08616 2E

Unsteady Flow to Wells in Layered and Fissured Aquifer Systems,
W87-08618 2F

Review of Methods of Parameter Estimation for the Extreme Value Type-1 Distribution,
W87-08619 7C

Finite Element Analysis of Water Flow in Variably Saturated Soil,
W87-08620 2G

Research Needs in Validating and Determining the Predictability of Laboratory Data to the Field,
W87-08631 5C

Advantages of Using Regression Analysis to Calculate Results of Chronic Toxicity Tests,
W87-08650 5C

Alternate Procedure for Analyzing Aquifer Tests Using the Theis Nonequilibrium Solution,
W87-08756 7C

Impact of the Dupuit-Forchheimer Approximation on Salt-Water Intrusion Simulation,
W87-08758 2F

Analysis of Horizontally Two-Dimensional Morphological Evolutions in Shallow Water,
W87-08782 7C

Rainfall Pattern Associated with a Split Cold Front as Seen on FRONTIERS,
W87-08800 2B

Hydrological Maps: Development of a System for Calculation and Presentation,
W87-08812 7C

WATBAL: A Semi-Distributed, Physically Based Hydrological Modelling System,
W87-08823 2G

Operational Spring Time Forecasting Difficulties and Improvements,
W87-08824 2E

Transformation of Input to a Stochastic Model Using a Distribution Deterministic Model,
W87-08825 2E

Empirical Prediction of the Summer Monsoon Rainfall over India,
W87-08940 2B

Estimating Baseflow Volume and its Uncertainty,
W87-08971 2E

Geographic Information System to Predict Non-Point Source Pollution Potential,
W87-08977 7A

Alternative Demand Model Estimators for Block Rate Pricing,
W87-08984 6C

Solute Transport During Absorption and Infiltration: A Comparison of Analytical Approximations,
W87-08990 7C

Elimination of Time Assignment Bias in Estimates of Dispersion Coefficient,
W87-08994 7C

Capillarity Correction for Free Surface Flow of Groundwater,
W87-09018 2F

Quasi-Solution of Richards' Equation for the Downward Infiltration of Water into Soil,
W87-09019 2G

Radar Rainfall Data Quality Control by the Influence Function Method,
W87-09022 7C

Error Analysis of Conventional Discrete and Gradient Dynamic Programming,
W87-09023 7C

Markov Renewal Model for Rainfall Occurrences,
W87-09025 7C

Statistical Modeling of Daily Rainfall Occurrences,
W87-09026 7C

Statistical Structure and Filter Characteristics of Tritium Fluctuations in Fractured Basalt,
W87-09027 5B

Robust-Resistant Spatial Analysis of Soil Water Infiltration,
W87-09029 7C

Simulation of the Borden Plume Using the Alternating Direction Galerkin Technique,
W87-09030 5B

Remote Sensing: Principles and Interpretation,
W87-09065 7B

Modeling the Flow of Immiscible Fluids in Soils,
W87-09258 2G

Safety Factor for LC50 Values Allowing for Differences in Sensitivity Among Species,
W87-09266 5C

Conformal-Mapping Technique for Topographic-Wave Problems: Semi-Infinite Channels and Elongated Basins,
W87-09384 7C

Scanning Currents in Stokes Flow and the Efficient Feeding of Small Organisms,
W87-09385 2H

DATA PRESENTATION
Hydrological Maps: Development of a System for Calculation and Presentation,
W87-08812 7C

DATA PROCESSING
Correction of Liquid Precipitation,
W87-08813 2B

Focus: Fisheries Oceanography Cooperative Users System,
W87-09500 7C

Data Intercomparison Theory IV. Tercile Tests for Location, Spread and Pattern Differences,
W87-09503 7C

Data Intercomparison Theory II. Trinity Statistics for Location, Spread and Pattern Differences,
W87-09504 7C

Data Intercomparison Theory III. S-Phase and T-Phase Tests for Spatial Pattern and Temporal Evolution,
W87-09505 7C

DATE PROCESSING

Data Intercomparison Theory I. Minimal Spanning Tree Tests for Location and Scale Differences,
W87-09501 7C

Data Intercomparison Theory V. Case Study: Effects of Objective Analysis on a Tropical Pacific Sea Surface Temperature Set,
W87-09502 7C

DEAD SEA

Surface Manifestations of Internal Oscillations in a Highly Saline Lake (the Dead Sea),
W87-08866 2H

DECIDUOUS TREES

Trees as Indicators of Subterranean Water Flow from a Retired Radioactive Waste Disposal Site,
W87-08845 5A

DECISION MAKING

Institutional Analysis in Community Decision-Making: A Case Example from Southern Arizona,
W87-08981 6A

Error Analysis of Conventional Discrete and Gradient Dynamic Programming,
W87-09023 7C

DECOMPOSING ORGANIC MATTER

Downward Movement of Partly Degraded Materials in Dyked Marsh Soils,
W87-08998 2H

DECOMPOSITION

Dynamics of Nitrogen and Carbon in Soil during Papermill Sludge Decomposition,
W87-08891 5E

DEER

Preventing Desert Mule Deer Drownings in the Mohawk Canal, Arizona,
W87-09152 6G

DELAWARE RIVER

Growth and Survival of Giant Ragweed (Ambrosia trifida L.) in a Delaware River Freshwater Tidal Wetland,
W87-08714 2H

DELAWARE SALT MARSH

Mechanisms of Enrichment at the Air-Water Interface,
W87-09169 5B

DENDROCHRONOLOGY

Ecological and Statistical Prognosis of the Dynamics of Fish Catch Based on Dendrochronological Data,
W87-08711 2H

DENITRIFICATION

Biological Denitrification of a Highly Nitrogenous Industrial Effluent: A Case Study in Zimbabwe,
W87-08964 5D

DENMARK

Review of Brown Trout (Salmo trutta) Spawning Beds, Indicating Methods for their Re-establishment in Danish Lowland Rivers,
W87-09047 2H

Physical Structure and Brown Trout (Salmo trutta fario) Populations in Small Danish Lowland Streams,
W87-09059 2H

Dispersal-Mediated Coexistence of Mud Snails (Hydrobiidae) in an Estuary,
W87-09422 2L

DENSITY STRATIFICATION

Surface Manifestations of Internal Oscillations in a Highly Saline Lake (the Dead Sea),
W87-08866 2H

DENTAL HEALTH

Epidemiology of Dental Caries in Relation to Environmental Trace Elements,
W87-08694 5C

DEPRESSION STORAGE

Rainfall Abstractions,
W87-09099 2A

DEPTH-AREA-DURATION ANALYSIS

Rainfall for Urban Stormwater Design,
W87-09098 2B

DESERT SOILS

Temperature Modelling of Wet and Dry Desert Soils,
W87-08791 2G

DESERTS

Irrigation with Brackish Water under Desert Conditions: IV. Salt Tolerance Studies with Lettuce (Lactuca sativa L.),
W87-08746 3C

Irrigation with Brackish Water under Desert Conditions: V. Nitrogen Requirement of Tomatoes (Lycopersicon esculentum Mill.) during Germination under Drip Irrigation,
W87-08747 3C

Temperature Modelling of Wet and Dry Desert Soils,
W87-08791 2G

DESIGN CRITERIA

Evaluations of the Recreational Potential of Reservoirs in Design Practice,
W87-09360 2H

Rational Design of Aerobic Digestion System,
W87-09370 5D

Scale-Up of Water and Wastewater Treatment Processes.
W87-09431 5D

Scale-Up and Scale-Down Concepts and Problems,
W87-09432 5D

Introduction to Scale-Up of Water and Wastewater Treatment Processes,
W87-09433 5D

Perspectives on the Scale-Up of Impeller Mixers,
W87-09434 5D

Important Issues in the Scale Up of New Processes,
W87-09435 5D

Ecohydrodynamics and Simulation: Some Relevant Problems of Scale-Up and -Down,
W87-09436 5C

Geometric Parameters and Efficiency of Diffused Air Systems,
W87-09437 5D

Significance of Oxygen Transfer Variables in the Sizing of Dome Diffuser Aeration Equipment,
W87-09438 5D

Optimization of Mechanical Aerators in a Hydraulic Two-Phase Flow Model and the Scale-Up of the Results for the Prototype,
W87-09439 5D

Factors of Scale in Rapid Sand Filtration,
W87-09440 5F

Scaling-Up Studies on Wastewater Sedimentation,
W87-09441 5D

Importance of Laboratory Scale Study for the Design of Mobile-Bed Filter,
W87-09442 5F

Unique Pre-Ozonation - D.E. Filtration Water Treatment Plant Design is Based on Pilot Plant Data,
W87-09443 5F

Development of a New Type of Fluidized Bed Reactor,
W87-09444 5D

Scale-Up of Solid Bowl Centrifuges for Sludge Dewatering,
W87-09445 5E

Modeling for Process Scale-Up of Adsorption and Ion Exchange Systems,
W87-09446 5D

Scale-Up of Direct Filtration (The Wahnbach System),
W87-09447 5F

Scale-Up of a Radium-226 Removal Process,
W87-09448 5D

Relationship Between Bench Scale and Prototype Activated Sludge Systems,
W87-09449 5D

Role of Kinetic Models for the Scale-Up of Biological Processes,
W87-09450 5D

Scale-Up of Activated Sludge and Trickling Filter Processes,
W87-09451 5D

Scale-Up of Biological Wastewater Treatment Processes: Practical Experiences in the U.K.,
W87-09453 5D

Development of a Competitive Two-Stage Biological Treatment System: Results of Pilot Plants and Full Scale Plants,
W87-09454 5D

Scale-Up Experience with the Waterloo SCP Process in Industrial Biomass Waste Treatment,
W87-09455 5D

Fixed-Cone Valve Prototype Tests, Final Series, New Melones Dam, California,
W87-09483 8C

Kahului Breakwater Stability Study, Kahului, Maui, Hawaii: Hydraulic Model Investigation,
W87-09488 8B

British Examples of a Hydrogeological Approach to the Evaluation of Drainage Problems in Subsurface Engineering,
W87-09593 2F

DESIGN STANDARDS

'Spray-Column' Laboratory Apparatus for Organic Matter Extraction from Sludges,
W87-08913 5A

DESIGN STANDARDS

Pulsed Nuclear Magnetic Resonance Instrument for Soil-Water Content Measurement: Sensor Configurations,
W87-08991 7B

Assignment of Strength Requirments of Concrete for Large Dams,
W87-09354 8F

Optimal Water Treatment Plant Design,
W87-09374 5F

DESORPTION
Kinetics of Sulfate Adsorption and Desorption by Cecil Soil Using Miscible Displacement,
W87-08995 2G

Desorption and Regeneration of Dye Colours from Low-Cost Materials,
W87-09279 5D

DETECTION LIMITS
Systematic Approach to Adsorption on XAD-2 Resin for the Concentration and Analysis of Trace Organics in Water Below the (mu)g/l Level,
W87-09011 5A

DETERGENTS
Removal of Detergents from Drinking Water with Ozone,
W87-09139 5F

DEVELOPING COUNTRIES
Semiarid Soil and Water Conservation,
W87-08661 3F

Irrigation in India: A Physiological and Phenological Approach to Water Management in Grain Crops,
W87-09468 3F

DEVELOPMENT
Regulatory Dilemmas Ensnare Arizona's Small Water Companies,
W87-08952 5F

DEWATERING
Scale-Up of Solid Bowl Centrifuges for Sludge Dewatering,
W87-09445 5E

Influence of Structure on Underground Water Prediction and Occurrence at Rokana Mine, Kitwe, Zambia,
W87-09572 2F

Mine and Open Pit Dewatering at Chingola, Zambia,
W87-09584 4B

DIATOMACEOUS EARTH
Unique Pre-Ozonation - D.E. Filtration Water Treatment Plant Design is Based on Pilot Plant Data,
W87-09443 5F

DIATOMS
Assessment of Effluent Impacts through Evaluation of Periphyton Diatom Community Structure,
W87-09320 5C

DICHLOROBENZENE
Biodegradability of para-Dichlorobenzene and Its Behaviour in Model Activated Sludge Plants,
W87-09269 5D

DICHLOROBENZIDINE
Mobility of Sludge-Borne 3,3'-Dichlorobenzidine in Soil Columns,
W87-08925 5B

DIETS
Residues of Organochlorine Chemicals and Concentrations of Heavy Metals in Ciconiforme Eggs in Relation to Diet and Habitat,
W87-08916 5B

Immunological Dietary Analysis of Two Penaeid Shrimp Species from a South Carolina Tidal Creek,
W87-08988 2L

DIFFUSERS
Internal Hydraulics of Diffusers with Uniform Lateral Momentum Distribution,
W87-09366 8B

DIFFUSIVE RESISTANCE
Responses of Leaf Water Potential and Leaf Diffusive Resistance to Abscisic Acid, Water Stress and Low Temperature in Hibiscus esculentus: The Effect of Water Stress and ABA Pre-Treatments,
W87-09210 2D

DIGESTION
Digestion of Carbohydrates and Protein by Gammarus mucronatus Say (Amphipoda),
W87-08839 2L

Complete HF Digestion Method for Element and Trace Element Determination in Soils, Sediments, Sludges and Other Similar Samples Using a Closed System (HF-Totalaufschluss im geschlossenen System fur Element- und Spurenelementbestimmungen in Boden, Klarschlamm, Sedimenten u. a. Proben),
W87-08894 5A

DIKED MARSHES
Downward Movement of Partly Degraded Materials in Dyked Marsh Soils,
W87-08998 2H

DIKES
Detailed Project Report and Environmental Assessment: Section 111, Shores East of Diked Disposal Area, Lorain Harbor, Ohio.
W87-09491 6G

DIMENSIONAL ANALYSIS
Introduction to Scale-Up of Water and Wastewater Treatment Processes,
W87-09433 5D

DIMETHYLNAPHTHALENES
Effects of Dimethylnaphthalene and Fluctuating Temperatures on Estuarine Shrimp,
W87-09517 5C

DIOXINS
Physical/Chemical Properties of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin,
W87-08657 5B

Environmental Mobility of Dioxins,
W87-08658 5B

Model for Estimating the Loading Rate of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin to the Great Lakes,
W87-08660 5B

Use of Bullfrogs (Rana catesbeiana) as Biological Markers for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin Contamination in the Environment,
W87-08733 5A

Embryotoxicity, Teratogenicity, and Aryl Hydrocarbon Hydroxylase Activity in Forster's Terns on Green Bay, Lake Michigan,
W87-08841 5C

DIQUAT
Lethal Effects of Diquat and Paraquat on Developing Frog Embryos and 15-Day-Old Tadpoles, Rana pipiens,
W87-09235 5C

DISASTERS
1986 Lake Nyos Gas Disaster in Cameroon, West Africa,
W87-08780 2H

DISCHARGE HYDROGRAPHS
Use of Topological Information in Hydrograph Estimation,
W87-08976 2E

DISCHARGE MEASUREMENT
Low Discharge Periods of Rivers in the Upper Vistula River Basin, Poland,
W87-08970 7B

Estimating Baseflow Volume and its Uncertainty,
W87-08971 2E

DISINFECTION
Handbook of Chlorination,
W87-09064 5D

Safe Drinking Water: The Impact of Chemicals on a Limited Resource.
W87-09114 5C

Drinking Water: A Global Victual,
W87-09116 5C

Disinfectant Chemistry In Drinking Water - Overview of Impacts on Drinking Water Quality,
W87-09122 5F

By-Products of Chlorination: Specific Compounds and Their Relationship to Total Organic Halogen,
W87-09123 5F

Ozone for Drinking Water Treatment - Evolution and Present Status,
W87-09124 5F

Handbook of Ozone Technology and Applications Volume II: Ozone for Drinking Water Treatment.
W87-09134 5F

Ozone Disinfection of Drinking Water,
W87-09135 5F

Trihalomethane Formation in Whirlpool Spas,
W87-09276 5B

Potassium Ferrioxalate as Chemical Actinometer in Ultraviolet Reactors,
W87-09377 5F

DISIPIDAE
Interaction of Euonymus scale (Homoptera:Diaspididae) Feeding Damage and Severe Water Stress on Leaff Abscission and Growth of Euonymus Fortunei,
W87-09344 2I

DISPERSANTS
Evaluation of Oil Spill Dispersant Testing Requirements,
W87-09508 5G

Laboratory Determination of Dispersant Effectiveness: Method Development and Results,
W87-09509 5G

View of the Laboratory Testing and Assessment of Oil Spill Dispersant Efficiency,
W87-09510 5G

Use of Dispersants on Viscous Fuel Oils and Water in Crude Oil Emulsions,
W87-09511 5G

Biodegration of Chemically Dispersed Crude Oil,
W87-09512 5B

Toxicity of Chemically Dispersed Oil to Shrimp Exposed to Constant and Decreasing Concentrations in a Flowing System,
W87-09516 5C

Assessment of Aerial Application of Oil Spill Dispersants,
W87-09533 5G

Aerial Application of Dispersants at the Ixtoc I Spill,
W87-09534 5G

Oil Spill Cleanup with Dispersants: A Boomed Oil Spill Experiment,
W87-09535 5G

1979 Southern California Dispersant Treated Research Oil Spills,
W87-09536 5G

Fate and Effects of Dispersant-Treated Compared with Untreated Crude Oil, with Particular Reference to Sheltered Intertidal Sediments,
W87-09537 5G

DISPERSION
Reduction in Hydraulic Conductivity in Relation to Clay Dispersion and Disaggregation,
W87-08996 2G

DISPERSION COEFFICIENTS
Elimination of Time Assignment Bias in Estimates of Dispersion Coefficient,
W87-08994 7C

DISPERSIVITY
Performance and Analysis of Aquifer Tracer Tests with Implications for Contaminant Transport Modeling - A Project Summary,
W87-08759 5B

DISPOSAL SITES
Basic Data Report for Drilling and Hydrologic Testing of Drillhole DOE-2 at the Waste Isolation Pilot Plant (WIPP) Site,
W87-09333 5E

DISSOLVED ORGANIC MATTER
Chromatographic Studies of Dissolved Organic Matter and Copper-Organic Complexes Isolated From Estuarine Waters,
W87-08960 7B

DISSOLVED OXYGEN
Effects of Lowered Dissolved Oxygen Concentration on the Toxicity of 1,2,4-Trichlorobenzene to Fathead Minnows,
W87-08879 5C

Thermal and Dissolved Oxygen Characteristics of a South Carolina Cooling Reservoir,
W87-08975 2H

Modelling of BOD-DO Dynamics in an Ice-Covered River in Northern China,
W87-09262 5B

DISTILLERY WASTE
Effects of Distillery Waste on the Performance of Cicer arietinum L.,
W87-08873 5C

DISTRIBUTION
Review of Methods of Parameter Estimation for the Extreme Value Type-1 Distribution,
W87-08619 7C

DISTRIBUTION PATTERNS
Catchment Effects on the Horizontal Distribution of Phytoplankton in Five of Scotland's Largest Freshwater Lochs,
W87-08790 2H

Distribution of Aromatic Hydrocarbons in Port Valdez, Alaska,
W87-09513 5B

Surveillance, Tracking, and Model Correlation of the Spill from the Tanker Burmah Agate,
W87-09520 7B

Simplified Models to Predict the Breakup of Oil on Rough Seas,
W87-09521 5B

Spreading, Dispersion, and Evaporation of Oil Slicks in the Arabian Gulf,
W87-09522 5B

Containment of Oil Spilled Under Rough Ice,
W87-09526 5B

Unique Inland Oil Spill - Glenrock, Wyoming,
W87-09532 5G

Mapping the Distribution of Protected and Valuable, Oil-Sensitive Coastal Fish and Wildlife,
W87-09540 7A

Comprehensive Model for Oil Spill Simulation,
W87-09552 5B

Coherent, Plunging Water Jets for Oil Spill Control,
W87-09565 5G

DIVERSION CHANNELS
Engineering Measures: Waterways and Diversion Channels,
W87-08666 8A

DIVERSION STRUCTURES
Geotechnical Aspects of Corani Reservoir Enlargement,
W87-08794 8A

Fish Diversion in Hydropower Intake,
W87-09197 8I

DNA
Thymidine Incorporation and Microbial Respiration in the Surface Sediment of a Hypereutrophic Lake,
W87-08936 2H

DOLORES PROJECT
Dolores Archaeological Program: Anasazi Communities at Dolores: Early Anasazi Sites in the Sagehen Flats Area,
W87-09330 6G

DOMESTIC WATER
Presence of Legionella in London's Water Supplies,
W87-08901 5F

Epidemiological Evidence of Legionellosis Transmission through Domestic Hot Water Supply Systems and Possibilities of Control,
W87-08905 5F

DOMESTIC WATER USE
Water Use and Health in Mueda, Mozambique,
W87-08777 5F

DRAIN FLOW
Effect of Upland Pasture Improvement on Nutrient Release in Flows from a 'Natural' Lysimeter and a Field Drain,
W87-08741 5G

DRAINAGE
Effect of Upland Pasture Improvement on Nutrient Release in Flows from a 'Natural' Lysimeter and a Field Drain,
W87-08741 5G

Transport of Solids in Streamflow from Coastal Plain Watersheds,
W87-08924 2J

Vacuum Trough Extractors for Measuring Drainage and Nitrate Flux Through Sandy Soils,
W87-08989 7B

Ameliorative Methods to Reinstate Fisheries Following Land Drainage Operations,
W87-09048 6G

Hydrology and Drainage of Peatland,
W87-09201 2G

Hydrogeological Aspects of Agricultural Drainage in Ireland,
W87-09203 2E

DRAINAGE BASINS
Selenium in the Tributaries of the Orinoco in Venezuela,
W87-09406 2K

DRAINAGE EFFECTS
Downward Movement of Partly Degraded Materials in Dyked Marsh Soils,
W87-08998 2H

DRAINAGE ENGINEERING
Attempts to Determine the Viability of a Deep Excavation on the Coast of the Vandellos Massif (Tarragona, Spain) (Ensayos Para Determinar la Viabilidad de una Excavacion Profunda en el Litoral del Macizo de Vandellos (Tarragona, Expana)),
W87-09574 2F

Exploitation and Control of Karst Water in Coal Measures,
W87-09575 2F

Hydrogeological Problems Affecting the Exploitation of the Peat Bog at Padul (Granad, Spain). Preliminary Study (Problemas Hidrogeologicos que Afectan a la Explotacion de la Turbera de Padul (Granad, Espana). Estudio Preliminar),
W87-09576 4A

Groundwater Control in Opencast Mining of a Lignite Deposit in Southern Greece,
W87-09583 4B

Mine and Open Pit Dewatering at Chingola, Zambia,
W87-09584 4B

Origin and Dynamics of the Waters Flowing into the Mining Works in Reocin (Santander, Spain) (Sobre el Origen y Dinamica de las Aguas Fluyentes a las Explotaciones Mineras de Reocin (Santander, Espana)),
W87-09586 2F

British Examples of a Hydrogeological Approach to the Evaluation of Drainage Problems in Subsurface Engineering,
W87-09593 2F

Some Hydrogeological Solutions to the Exploitation of Underground Lignite Mines (Quelques Solutions Hydrogeologiques dans la Construction des Mines de Lignite Souterraines),
W87-09597 4B

Water Control Strategy of Mines Under Strong Karstic Water Hazard,
W87-09600 4B

DRAINAGE PRACTICES
Agricultural Drainage Practices in Ireland,
W87-09202 4A

DRAINAGE SYSTEMS
Role of the Fisheries Engineer in the Design and Execution of Arterial Drainage Schemes,
W87-09044 8I

DRAWDOWN
Unsteady Flow to Wells in Layered and Fissured Aquifer Systems,
W87-08618 2F

Predictive Application of an ORNL Geohydrology Model,
W87-08760 7C

DREDGING
Dredging of Rapids for Timber-Floating in Finland and Its Effects on River-Spawning Fish Stocks,
W87-09045 6G

Physical and Biological Effects of Gravel Extraction in River Beds,
W87-09049 4C

Development of a Simplified Column Test for Evaluation of Thickness of Capping Material Required to Isolate Contaminated Dredged Material,
W87-09091 5G

Regulatory Identification of Petroleum Hydrocarbons in Dredged Material,
W87-09154 5A

Social and Economic Impacts of Selected Potential Dredged Material Containment Facilities in Long Island Sound.
W87-09471 6B

Dredged Material Containment in Long Island Sound (With Special Emphasis on Eastern New York Waters),
W87-09474 8A

Pumping Performance and Turbidity Generation of Model 600/100 Pneuma Pump: Main Text and Appendixes A and B,
W87-09487 8C

DRILLING
Basic Data Report for Drilling and Hydrologic Testing of Drillhole DOE-2 at the Waste Isolation Pilot Plant (WIPP) Site,
W87-09333 5E

DRINKING WATER
Recovery of Water from Atmospheric Air in Arid Climates,
W87-08601 5F

Geochemistry, Soils and Cardiovascular Diseases,
W87-08692 2F

Bacteriological Quality of Drinks From Vending Machines,
W87-08704 5F

Heavy Metal Pollution of the Mid-Canal of Kandy: An Environmental Case Study from Sri Lanka,
W87-08840 5C

Age-Dependent Lung Doses from Ingested 222Rn in Drinking Water,
W87-08844 5C

Operational Variables and the Release of Colonized Granular Activated Carbon Particles in Drinking Water,
W87-08957 5F

Committee Report: Microbiological Considerations for Drinking Water Regulation Revisions,
W87-08959 5F

Safe Drinking Water: The Impact of Chemicals on a Limited Resource.
W87-09114 5C

Chemicals and Safe Drinking Water: National and International Perspective,
W87-09115 5C

Drinking Water: A Global Victual,
W87-09116 5C

Public Drinking Water and Chemicals,
W87-09117 5C

Bottled Water: An Alternative Source of Safe Drinking Water,
W87-09118 5F

Overview of Point-of-Use Water Treatment Technology,
W87-09119 5F

Effective Alternative to Official Regulation of Indirect Additives to Drinking Water,
W87-09120 5F

Water Treatment Chemicals Codex,
W87-09121 5F

Disinfectant Chemistry In Drinking Water - Overview of Impacts on Drinking Water Quality,
W87-09122 5F

By-Products of Chlorination: Specific Compounds and Their Relationship to Total Organic Halogen,
W87-09123 5F

Ozone for Drinking Water Treatment - Evolution and Present Status,
W87-09124 5F

Occurence of Contamination In Drinking Water From Groundwater Sources,
W87-09125 5B

Regulation of Contaminants In Drinking Water,
W87-09128 5F

Federal Protection of Groundwater,
W87-09129 5G

World Health Organization and Guidelines and European Economic Community Directives,
W87-09130 6E

Regulatory Flexibility and Consumer Options Under the Safe Drinking Water Act,
W87-09131 5F

Structure and Regulation of the European Bottled Water Industry,
W87-09132 5F

Congressional Initiatives,
W87-09133 5G

Handbook of Ozone Technology and Applications Volume II: Ozone for Drinking Water Treatment.
W87-09134 5F

Ozone Disinfection of Drinking Water,
W87-09135 5F

Removal of Iron and Manganese by Ozone during Drinking Water Treatment in Dusseldorf,
W87-09136 5F

Control of Tastes and Odors in Drinking Water with Ozone,
W87-09137 5F

Removal of Color from Drinking Water with Ozone,
W87-09138 5F

Removal of Detergents from Drinking Water with Ozone,
W87-09139 5F

Removal of Pesticides from Drinking Water with Ozone,
W87-09140 5F

Removal of Ammonia and Other Nitrogen Derivatives from Drinking Water with Ozone,
W87-09141 5F

Biological Drinking Water Treatment Systems Involving Ozone,
W87-09144 5F

Raw Water Preozonation,
W87-09145 5F

Recent Developments in the Treatment of Drinking Water with Ozone,
W87-09146 5F

Ozone for Drinking Water Treatment: A Bibliography,
W87-09147 5F

Water Treatment: The States Zero in on Groundwater Regulation,
W87-09222 5F

Survival and Multiplication of Legionella pneumophila in Municipal Drinking Water Systems,
W87-09389 5F

Antibiotic-Resistant Pseudomonas in Bottled Drinking Water,
W87-09424 5F

DRIPPERS
Field Method for Estimating Hydraulic Conductivity and Matric Potential-Water Content Relations,
W87-08993 2G

DROUGHT
Nitrogenase Activity, Photosynthesis and Nodule Water Potential in Soyabean Plants Experiencing Water Deprivation,
W87-08798 2I

Physiological Responses to Drought of Lolium perenne L.: Measurement of, and Genetic Variation in, Water Potential, Solute Potential, Elasticity and Cell Hydration,
W87-08848 2D

DROUGHT EFFECTS
Interaction of Euonymus scale (Homoptera:Diaspididae) Feeding Damage and Severe Water Stress on Leaff Abscission and Growth of Euonymus Fortunei,
W87-09344 2I

Impact of Irrigation and Experimental Drought Stress on Leaf-Mining Insects of Emory Oak,
W87-09402 2I

Glutathione Status and Protein Synthesis During Drought and Subsequent Rehydration in Tortula ruralis,
W87-09417 2I

DROWNING
Preventing Desert Mule Deer Drownings in the Mohawk Canal, Arizona,
W87-09152 6G

DRY DEPOSITION
Transport and Dry Deposition of Trace Metals over Southern Lake Michigan,
W87-09179 5B

DTPA
Ammonium Bicarbonate-DTPA and DTPA Extractions of Sludge-Amended Soils,
W87-08923 5A

DUCKS
Heavy Metal Concentrations in the Liver of Three Duck Species: Influence of Species and Sex,
W87-09380 5B

DUCKWEED
Toxicity of Aqueous Extracts of Natural and Synthetic Oils to Three Species of Lemna,
W87-08647 5C

Toxicity and Bioaccumulation of Cadmium in Experimental Cultures of Duckweed, Lemna polyrrhiza L.,
W87-09241 5C

DUISBURG
Closed-Loop System for Generating Ozone from Oxygen and Its Application to the Treat-

ment of Drinking Water at Duisburg, Federal Republic of Germany,
W87-09143 5F

DUPUIT-FORCHHEIMER APPROXIMATION
Impact of the Dupuit-Forchheimer Approximation on Salt-Water Intrusion Simulation,
W87-08758 2F

DUSSELDORF
Removal of Iron and Manganese by Ozone during Drinking Water Treatment in Dusseldorf,
W87-09136 5F

DYES
Acute and Chronic Toxicity to the Fathead Minnow, Pimephales promelas, of Effluents from a Treatment Plant Receiving Dye and Pigment Processing Wastewater,
W87-08656 5C

Limits of Bioaccumulation of Organic Pigments in Fish: Their Relation to the Partition Coefficient and the Solubility in Water and Octanol,
W87-08853 5B

Desorption and Regeneration of Dye Colours from Low-Cost Materials,
W87-09279 5D

DYNAMIC PROGRAMMING
Error Analysis of Conventional Discrete and Gradient Dynamic Programming,
W87-09023 7C

DYNAMITE LAKE
Effects of Food Availability and Fish Predation on a Zooplankton Community,
W87-08799 2H

EARTH DAMS
2-D Elastoplastic Seismic Shear Response of Earth Dams: Theory,
W87-08607 8A

2-D Elastoplastic Seismic Shear Response of Earth Dams: Applications,
W87-08608 8A

Considertion of the Stress-Strain State in Calculations of Slope Stability of Earth Dams,
W87-09356 8D

EARTHQUAKES
2-D Elastoplastic Seismic Shear Response of Earth Dams: Theory,
W87-08607 8A

2-D Elastoplastic Seismic Shear Response of Earth Dams: Applications,
W87-08608 8A

EASTERN AUSTRALIA
Rainfall Kinetic Energy in Eastern Australia,
W87-08698 2B

ECHINODERMS
Rapid Aquatic Toxicity Assay Using Incorporation of Tritiated-Thymidine into Sea Urchin, Arbacia punctulata, Embryo: Evaluation of Toxicant Exposure Procedures,
W87-08655 5C

ECOLOGICAL DISTRIBUTION
Regulation of Submerged Aquatic Plant Distribution in a Uniform Area of a Weedbed,
W87-08836 2H

ECOLOGICAL EFFECTS
Geothermal Reservoir Engineering Experience in Iceland,
W87-08830 6G

Effect of Polluted and Leached Snow Melt Waters on the Soil Bacterial Community--Quantitative Response,
W87-08874 5C

Impact-Sensitiveness of Soil Oribatid Species to the Waste Water from a Coal Distillation Plant,
W87-08898 5A

Food of Whitefish (Coregonus lavaretus) in Two Neighbouring Lakes, One Regulated and the Other Natural,
W87-09055 2H

Effect of Recreational Uses Upon Aquatic Ecosystems and Fish Resources,
W87-09060 6G

Afforestation and Fisheries,
W87-09061 4C

Man-Induced Gradient Adjustment of the South Fork Forked Deer River, West Tennessee,
W87-09206 6G

Drowning of a Culture,
W87-09231 6G

Environmental Impact Analysis of Aquatic Ecosystems Using Rational Threshold Value Methodologies,
W87-09313 5C

Examination of Tidal Flats, Vol. 3: Evaluation Methodology.
W87-09493 4C

Coastal Ecosystem Studies and Their Application to Oil Spill Response,
W87-09539 5C

Mapping the Distribution of Protected and Valuable, Oil-Sensitive Coastal Fish and Wildlife,
W87-09540 7A

Impact of Oil on Marsh Communities in the St. Lawrence River,
W87-09541 5C

Polycyclic Aromatic Hydrocarbons in Oysters (Crassostrea Virginica) from Georgia Coastal Waters, Analyzed by High-Pressure Liquid Chromatography,
W87-09542 5A

Ixtoc I Oil Spill - The Damage Assessment Program and Ecological Impact,
W87-09554 5C

Effect of Crude Oil on Microbial Processes in Marine Sediments,
W87-09567 5C

ECOLOGY
Macrofossil and Pollen Representation of Coniferous Trees In Modern Sediments from Washington,
W87-08690 2H

Hydrology, Water Chemistry and Ecological Relations in the Raised Mound of Cowles Bog,
W87-08837 2H

Association between Legionella pneumophila and Amoebae in Water,
W87-08906 5F

Ecology of Estuaries, Volume I: Physical and Chemical aspects,
W87-09066 2H

Geochemistry and Ecological Role of Humic Substances in Lakewater,
W87-09071 2H

Plants and Peat Cuttings: Historical Ecology of a Much Exploited Peat land-Thorne Waste. Yorkshire, UK,
W87-09342 4C

ECONOMIC ASPECTS
Innovative State Policies for Aiding Community Water Suppliers,
W87-08951 5F

Applying Economic Principles to Small Water Systems,
W87-08955 6C

Allocation Model for Irrigation Water Cost: Case Study of the Nile Valley in Egypt,
W87-08968 6C

Alternative Demand Model Estimators for Block Rate Pricing,
W87-08984 6C

Production Functions for Water Delivery Systems: Analysis and Estimation Using Dual Cost Function and Implicit Price Specifications,
W87-09014 6D

Economic Differences Between Cumulative and Episodic Reduction of Sediment from Cropland,
W87-09090 2J

Groundwater Management in France,
W87-09205 2F

Economic, Legal, and Hydrologic Dimensions of Potential Interstate Water Markets,
W87-09211 6C

Irrigated Agriculture and Groundwater Quality--A Framework for Policy Development,
W87-09212 6A

Economics of the Treatment of Dairy Cow Slurry by Anaerobic Digestion,
W87-09216 5D

Factors Affecting Water and Wastewater Rates,
W87-09221 6C

ECOSYSTEMS
Pollutant Sorption in Environmental Systems,
W87-08677 5B

Introduction of Mysis relicta in Sweden: Effects on Fish in Impounded Lakes,
W87-09057 2H

Assessment of Effluent Impacts through Evaluation of Periphyton Diatom Community Structure,
W87-09320 5C

EFFLUENTS
Soil Clogging During Subsurface Wastewater Infiltration as Affected by Effluent Composition and Loading Rate,
W87-08928 5C

Elimination of Time Assignment Bias in Estimates of Dispersion Coefficient,
W87-08994 7C

Effluent Evaluation,
W87-09302 5A

Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms.
W87-09311 5C

Evaluation of the Effects of Effluents on Aquatic Life in Receiving Waters - An Overview,
W87-09312 5C

Application of Laboratory Scale Model Streams Toward Assessing Effluent Impacts in Freshwater Lotic Environments,
W87-09314 5C

Assessment and Prediction of Impacts of Effluents on Communities of Benthic Stream Macroinvertebrates,
W87-09324 5C

Effects of Pollution by Organic Sugar Mill Effluent on the Macro-invertebrates of a Stream in Tropical Queensland, Australia,
W87-09421 5C

EFFLUENTS

Toxicity of Ballast-Water Treatment Effluent to Marine Organisms at Port Valdez, Alaska,
W87-09514 5C

Effectiveness of Offshore Produced Water Treatment,
W87-09515 5D

Ten Years of Saltmarsh Monitoring - The Case History of a Southampton Water Saltmarsh and a Changing Refinery Effluent Discharge,
W87-09545 5C

ELASTICITY

Physiological Responses to Drought of Lolium perenne L.: Measurement of, and Genetic Variation in, Water Potential, Solute Potential, Elasticity and Cell Hydration,
W87-08848 2D

ELECTRIC POWER

Status of DOE Small Hydropower Research and Development Projects.
W87-09478 8C

ELECTRICAL EQUIPMENT

Measures to Reduce the Level of Vibrations of Turbine-Generator Units,
W87-09365 8C

ELECTROCHEMICAL ANALYSIS

Electrochemical Analysis of Organic Pollutants,
W87-08612 5A

ELECTRODE CONTROLLER

Digital Controller for Discrete Stage Activation of Automatic Pumping Samplers,
W87-08983 7B

ELECTROFISHING

Role of Electrofishing in Assessing Environmental Quality of the Wabash River,
W87-09328 5A

ELECTROMETRIC DETERMINATION

Theory and Practice in the Electrometric Determination of pH in Precipitation,
W87-08949 7B

ELECTRON CAPTURE GAS CHROMATOGRAPHY

Research in Environmental Pollution: II. Determination of Polychlorinated Nitrobenzenes (PCNB's) in Main River Fish,
W87-08895 5A

ELISA

A-ELISA to Detect Hepatitis A Virus in Estuarine Samples,
W87-09396 5A

ELLISFORD

Ellisford Cremations: Internecine Hostilities in the 5th Century A.D.,
W87-09162 6G

EMBANKMENT DAMS

Monitoring Programme for Embankment Dams,
W87-09409 8A

EMBANKMENTS

Embankment Dam Instrumentation Manual,
W87-09157 8A

EMBRYOS

Rapid Aquatic Toxicity Assay Using Incorporation of Tritiated-Thymidine into Sea Urchin, Arbacia punctulata, Embryo: Evaluation of Toxicant Exposure Procedures,
W87-08655 5C

Lethal Effects of Diquat and Paraquat on Developing Frog Embryos and 15-Day-Old Tadpoles, Rana pipiens,
W87-09235 5C

EMISSIONS

Response of Lake Sediments to Changes in Trace Metal Emission from the Smelters at Sudbury, Ontario,
W87-09245 5B

EMULSIONS

Use of Dispersants on Viscous Fuel Oils and Water in Crude Oil Emulsions,
W87-09511 5G

ENDANGERED SPECIES

Valuing Wildlife in Benefit-Cost Analyses: A Case Study Involving Endangered Species,
W87-09032 6B

ENGINEERING

Geothermal Reservoir Engineering Experience in Iceland,
W87-08830 6G

Role of the Fisheries Engineer in the Design and Execution of Arterial Drainage Schemes,
W87-09044 8I

Ameliorative Methods to Reinstate Fisheries Following Land Drainage Operations,
W87-09048 6G

ENGINEERING GEOLOGY

Attempts to Determine the Viability of a Deep Excavation on the Coast of the Vandellos Massif (Tarragona, Spain) (Ensayos Para Determinar la Viabilidad de una Excavacion Profunda en el Litoral del Macizo de Vandellos (Tarragona, Expana)),
W87-09574 2F

ENGLAND

Snow Forecasts from the Meteorlogical Office Fine-mesh Model During the Winter of 1985/86,
W87-08702 2B

Ameliorative Methods to Reinstate Fisheries Following Land Drainage Operations,
W87-09048 6G

Effect of Habitat Modification on Freshwater Fisheries in Lowland Areas of Eastern England,
W87-09050 2H

Assessment of the Flow Requirements for Upstream Migration of Salmonids in Some Rivers of North-West England,
W87-09058 2H

ENRICHMENT

Mechanisms of Enrichment at the Air-Water Interface,
W87-09169 5B

Principles and Problems of Modeling Cation Enrichment at Natural Air-Water Interfaces,
W87-09170 5B

ENVIRONMENTAL EFFECTS

Environmental Systems Analysis: An Overview,
W87-08671 5B

Multiattribute Analysis of the Impact on Society of Phosphorus Abatement Measures,
W87-09013 5G

Effects on Fisheries of Non-Biotic Modifications of the Environment in the East-Danube River Area,
W87-09038 6G

Fall of Migratory Fish Populations and Changes in Commercial Fisheries in Impounded Rivers in Poland,
W87-09039 6G

Effects of Impoundment and Regulation of the River Tees at Cow Green (Northern Pennines, UK) Upon Fish Populations in Afferent Tributaries and in the River Immediately Downstream of the Dam,
W87-09040 6G

Repurcussion of Small Hydroelectric Power Stations on Populations of Brown Trout (Salmo trutta) in Rivers in the French Massif-Central,
W87-09041 6G

Review of Effects of Environmental Degradation on the Freshwater Stages of Anadromous Fish,
W87-09042 2H

Adverse Effects of Channelization and Their Amelioration,
W87-09043 6G

Dredging of Rapids for Timber-Floating in Finland and Its Effects on River-Spawning Fish Stocks,
W87-09045 6G

Ameliorative Methods to Reinstate Fisheries Following Land Drainage Operations,
W87-09048 6G

Physical and Biological Effects of Gravel Extraction in River Beds,
W87-09049 4C

Effects on Salmonid Populations of Isolation of a Lake From a River System,
W87-09051 6G

Development of Fish Stock and Fish Populations in Lake Inari,
W87-09054 2H

Drowning of a Culture,
W87-09231 6G

Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms.
W87-09311 5C

Environmental Impact Analysis of Aquatic Ecosystems Using Rational Threshold Value Methodologies,
W87-09313 5C

Establishment of Biotic Communities Within a Newly Constructed Ash Settling Basin and Its Drainage System,
W87-09323 5E

Physical and Chemical Behavior and Environmental Acceptability of Stabilized Scrubber Sludge and Fly Ash in Seawater,
W87-09327 5B

Detailed Project Report and Environmental Assessment: Section 111, Shores East of Diked Disposal Area, Lorain Harbor, Ohio.
W87-09491 6G

Examination of Tidal Flats, Vol. 3: Evaluation Methodology.
W87-09493 4C

Manual of Stream Channelization Impacts on Fish and Wildlife,
W87-09497 6G

Focus: Fisheries Oceanography Cooperative Users System,
W87-09500 7C

Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup).
W87-09507 5B

Effects of Dimethylnaphthalene and Fluctuating Temperatures on Estuarine Shrimp,
W87-09517 5C

Onshore Impacts and Cleanup During the Burmah Agate Oil Spill - November 1979,
W87-09518 5C

Wreck of the Lee Wang Zin,
W87-09528 5G

Coastal Ecosystem Studies and Their Application to Oil Spill Response,
W87-09539 5C

Mapping the Distribution of Protected and Valuable, Oil-Sensitive Coastal Fish and Wildlife,
W87-09540 7A

Impact of Oil on Marsh Communities in the St. Lawrence River,
W87-09541 5C

Geomorphological Alteration of a Heavily Oiled Saltmarsh (Ile Grande, France) as a Result of Massive Cleanup,
W87-09543 5B

Fate of the Zoe Colocotroni Oil Spill and its Effects on Infaunal Communities Associated with Mangroves,
W87-09544 5C

Effects of Oil Spill Cleanup Techniques on a Salt Marsh,
W87-09548 5C

Impact of the Esso Bayway Oil Spill on Salt Marsh Macro Fauna,
W87-09550 5C

Impacts of a Spill of No. 6 Fuel Oil on Lake Winona,
W87-09551 5C

Atlantic Empress Sinking - A Large Spill Without Environmental Disaster,
W87-09553 5C

Effects of the Ixtoc I Oil Spill on Texas Shorebird Populations,
W87-09555 5C

Impact and Persistence of Ixtoc I Oil on the South Texas Coast,
W87-09557 5C

Effects of Oil Spills on Mangrove Forests: A Comparison of Five Oil Spill Sites in the Gulf of Mexico and the Caribbean Sea,
W87-09558 5C

Effect of Crude Oil on Microbial Processes in Marine Sediments,
W87-09567 5C

Hydrogeological Aspects of Coal Mining Under Stored Waters Near Sydney, Australia,
W87-09587 2F

ENVIRONMENTAL LAW

Environmental Legislation,
W87-09299 6E

ENVIRONMENTAL QUALITY

Quantitative and Qualitative Aspects of Fish Crop in Relation to Environmental Quality,
W87-08855 5C

State of the Environment, 1985.
W87-09336 6G

ENVIRONMENTAL SPECIMEN BANK

Environmental Specimen Bank Specific Reference Materials - Main Aims and Preparation,
W87-08918 5A

ENZYMES

Digestion of Carbohydrates and Protein by Gammarus mucronatus Say (Amphipoda),
W87-08839 2L

Embryotoxicity, Teratogenicity, and Aryl Hydrocarbon Hydroxylase Activity in Forster's Terns on Green Bay, Lake Michigan,
W87-08841 5C

Effect of Ingested Benzo(a)pyrene and Cadmium on Tissue Accumulation, Hydroxylase Activity, and Intestinal Morphology of the Black Sea Bass, Centropristis striata,
W87-08842 5C

Xenobiotic-Metabolizing Enzyme Systems in Test Fish: I. Comparative Studies of Liver Microsomal Monooxygenases,
W87-08852 5C

Long-Term Effects of Bleached Kraft Mill Effluents on Carbohydrate Metabolism and Hepatic Xenobiotic Biotransformation Enzymes in Fish,
W87-08854 5C

Influence of Cadmium Exposure on Selected Hematological Parameters in Freshwater Teleost, Notemigonus crysoleucas,
W87-08857 5C

Induction of Crassulacean Acid Metabolism in Mesembryanthemum crystallinum by High Salinity: Mass Increase and de Novo Synthesis of PEP-Carboxylase,
W87-09418 3C

EPIDEMIOLOGY

Epidemiology of Dental Caries in Relation to Environmental Trace Elements,
W87-08694 5C

Epidemiological Evidence of Legionellosis Transmission through Domestic Hot Water Supply Systems and Possibilities of Control,
W87-08905 5F

Association between Legionella pneumophila and Amoebae in Water,
W87-08906 5F

Exposure to Legionella in Geriatric Institutions,
W87-08907 5B

Chemicals and Safe Drinking Water: National and International Perspective,
W87-09115 5C

Drinking Water: A Global Victual,
W87-09116 5C

Public Health Significance of Industrial Pollution in Zaria, Nigeria,
W87-09226 5B

EPILIMNION

Mathematical Model of Seasonal and Spatial Variation in Phosphorus Concentrations in Lake Memphremagog, Quebec,
W87-08899 5B

EPIPHYTES

Photosynthesis and Light Adaptation in Epiphyte-Macrophyte Associations Measured by Oxygen Microelectrodes,
W87-08935 7B

Effects of Water Stress on Gas Exchange and Water Relations of Succulent Epiphyte, Kalanchoe Uniflora,
W87-09347 2I

EQUILIBRIA

Aquatic Chemistry: An Introduction Emphasizing Chemical Equilibria in Natural Waters,
W87-09340 2A

EQUILIBRIUM

Equilibrium Models for the Initial Integration of Physical and Chemical Properties,
W87-08683 5B

EROSION

Soil Erosion Process,
W87-08663 2J

Effect of Soil Slip Erosion on Wairoa Hill Pasture Production and Composition,
W87-08734 2J

Counting the Days Along Lake Michigan,
W87-08804 2J

Slope Gradient Effect on Erosion of Reshaped Spoil,
W87-09000 2J

Relationships Between Waterdrop Properties and Forces of Impact,
W87-09004 2J

Detailed Project Report and Environmental Assessment: Section 111, Shores East of Diked Disposal Area, Lorain Harbor, Ohio.
W87-09491 6G

EROSION CONTROL

Agronomic Measures for Soil and Water Conservation,
W87-08664 3F

Gulley Control,
W87-08669 3F

Erosion and Sediment Control Handbook,
W87-08686 4D

Erosion Control of Scour During Construction; Report 6: FINITE - A Numerical Model for Combined Refraction and Diffraction of Waves,
W87-09482 8B

ERROR ANALYSIS

Error Analysis of Conventional Discrete and Gradient Dynamic Programming.
W87-09023 7C

ESTIMATING

Generalized Method of Moments as Applied to Problems of Flood Frequency Analysis: Some Practical Results for the Log-Pearson Type 3 Distribution,
W87-08616 2E

Review of Methods of Parameter Estimation for the Extreme Value Type-1 Distribution,
W87-08619 7C

ESTUARIES

Modeling Chemical Transport in Lakes, Rivers, and Estuarine Systems,
W87-08672 5B

Geochemical Partitioning of Heavy Metals in Sediments of Three Estuaries Along the Coast of Rio de Janeiro (Brazil),
W87-08717 2L

Adsorptive Behavior of Butyltin Compounds Under Simulated Estuarine Conditions,
W87-08730 5B

Seasonality of Blue Mussel, Mytilus edulis L., Larvae in the Damariscotta River Estuary, Maine, 1969-77,
W87-08849 2L

Resuspension in the Shallow Sublittoral Zone of a Macrotidal Estuarine Environment: Wind Influence,
W87-08933 2L

Chromatographic Studies of Dissolved Organic Matter and Copper-Organic Complexes Isolated From Estuarine Waters,
W87-08960 7B

Ecology of Estuaries, Volume I: Physical and Chemical aspects,
W87-09066 2H

Geochemistry of Humic Substances in Estuarine Environments,
W87-09074 2H

Degradation of Aniline and Chloroanilines by Sunlight and Microbes in Estuarine Water,
W87-09271 5B

ESTUARIES

Hydrological and Chemical Factors Controlling the Concentrations of Fe, Cu, Zn and As in a River System Contaminated by Acid Mine Drainage,
W87-09277 5B

Power-Plant-Related Estuarine Zooplankton Studies,
W87-09316 5C

Use of Monodispersed, Fluorescently Labeled Bacteria to Estimate In Situ Protozoan Bacterivory,
W87-09388 2H

A-ELISA to Detect Hepatitis A Virus in Estuarine Samples,
W87-09396 5A

Dispersal-Mediated Coexistence of Mud Snails (Hydrobiidae) in an Estuary,
W87-09422 2L

ESTUARINE ENVIRONMENT

Seasonality of Blue Mussel, Mytilus edulis L., Larvae in the Damariscotta River Estuary, Maine, 1969-77,
W87-08849 2L

Acute Toxicity of Emulsifiable Concentrations of Three Insecticides Commonly Found in Nonpoint Source Runoff into Estuarine Waters to the Mummichog, Fundulus heteroclitus,
W87-08881 5C

ETHREL

Effects of Flooding, Tilting of Stems, and Ethrel Application on Growth, Stem Anatomy and Ethylene Production of Pinus Densiflora Seedlings,
W87-08797 2I

EUCALYPTS

Water Use of Eucalypts - A Review with Special Reference to South India,
W87-08749 6G

EUCALYPTUS

Effect of Waterlogging on Infection of Eucalyptus marginata Seedlings by Phytophthora cinnamomi,
W87-09401 2I

EUROPEAN ECONOMIC COMMUNITY

World Health Organization and Guidelines and European Economic Community Directives,
W87-09130 6E

EUTROPHIC LAKES

Pattern of Organic Matter Production by Natural Phytoplankton Population in a Eutrophic Lake 1. Intracellular Products,
W87-08767 2H

Carbon Isotope Fractionation and Changes in the Flux and Composition of Particulate Matter Resulting from Biological Activity during a Sediment Trap Experiment in Lake Greifen, Switzerland,
W87-08867 2H

Correlation of a Lake Eutrophication Model to Field Experiments,
W87-08900 2H

EUTROPHIC MARSHES

Production-Destruction Processes in Ecosystems of Grassy Marshes of the Amur River Region,
W87-08709 2H

EUTROPHICATION

Qualitative Model of Eutrophication in Macrophyte Lakes,
W87-08785 2H

Correlation of a Lake Eutrophication Model to Field Experiments,
W87-08900 2H

Ecology of a Cryptomonas phaseolus Population Forming a Metalimnetic Bloom in Lake Ciso, Spain: Annual Distribution and Loss Factors,
W87-08930 2H

Impact of Agriculture on Surface Water in Ireland: Part I. General,
W87-09199 5B

Impact of Agriculture on Surface Water in Ireland: Part II. Prospects for the Future,
W87-09200 4C

EVALUATION

Field Validation,
W87-09300 7A

Chemical Safety Evaluation,
W87-09301 5B

State of the Environment, 1985.
W87-09336 6G

Examination of Tidal Flats, Vol. 1: Research Report.
W87-09492 4C

EVAPORATION

Effect of Exchangeable Sodium Percent on Surface Sealing,
W87-08742 4D

Bare Soil Evaporation Near a Surface Point-Source Emitter,
W87-08743 2D

Soil Water Evaporation Comparisons Among Tillage Practices in the Northern Great Plains,
W87-09006 2D

Estimating Evapotranspiration,
W87-09469 2D

EVAPOTRANSPIRATION

Water Production Functions for Wheat under Different Environmental Conditions,
W87-08748 3F

Spatial Variability of Soil Water and Evapotranspiration,
W87-08815 2G

Simulation of the Hydrologic Cycle for Watersheds,
W87-09111 2A

Advances in Irrigation, Volume 3.
W87-09464 3F

Estimating Evapotranspiration,
W87-09469 2D

EXCAVATION

Mine Drainage Problems in Indian Coalfields, with Special Reference to the Problems in Jharia Coalfield,
W87-09571 4C

Attempts to Determine the Viability of a Deep Excavation on the Coast of the Vandellos Massif (Tarragona, Spain) (Ensayos Para Determinar la Viabilidad de una Excavacion Profunda en el Litoral del Macizo de Vandellos (Tarragona, Expana)),
W87-09574 2F

EXISTENCE VALUE

Exploring Existence Value,
W87-09031 6C

EXTRACTION

Ammonium Bicarbonate-DTPA and DTPA Extractions of Sludge-Amended Soils,
W87-08923 5A

Accuracy of Selective Extraction Procedures for Metal Speciation in Model Aquatic Sediments,
W87-08985 5A

EXTREME VALUE DISTRIBUTIONS

Review of Methods of Parameter Estimation for the Extreme Value Type-1 Distribution,
W87-08619 7C

FAILURES

Concrete Temperature Control During Dam Construction,
W87-09408 8F

FARM WASTES

Impact of Agriculture on Surface Water in Ireland: Part I. General,
W87-09199 5B

Impact of Agriculture on Surface Water in Ireland: Part II. Prospects for the Future,
W87-09200 4C

Nonpoint Agricultural Pollution: Pesticide Contamination of Groundwater Supplies,
W87-09213 5B

FATE OF POLLUTANTS

Research Needs in Validating and Determining the Predictability of Laboratory Data to the Field,
W87-08631 5C

Modeling Chemical Transport in Lakes, Rivers, and Estuarine Systems,
W87-08672 5B

Environmental Exposure from Chemicals.
W87-08675 5B

Estimation of Physical Properties,
W87-08676 5B

Pollutant Sorption in Environmental Systems,
W87-08677 5B

Biodegradation,
W87-08680 5B

Hydrolysis,
W87-08681 5B

Photochemical Transformations,
W87-08682 5B

Equilibrium Models for the Initial Integration of Physical and Chemical Properties,
W87-08683 5B

Growth of Mixed Microbial Populations in Ground Water Containing Highly Chlorinated Organic Wastes,
W87-08878 5B

Mathematical Model of Seasonal and Spatial Variation in Phosphorus Concentrations in Lake Memphremagog, Quebec,
W87-08899 5B

Fate of 14C-Lindane in a Rice-Fish Model Ecosystem,
W87-08915 5B

Mobility of Sludge-Borne 3,3'-Dichlorobenzidine in Soil Columns,
W87-08925 5B

Chemical Contaminants in Bottomfish,
W87-09035 5B

Acid Neutralizing Capacity of Fine Soil Fractions,
W87-09180 2G

Lichens as Monitors of Atmospheric Deposition,
W87-09181 5C

Biodegradability of para-Dichlorobenzene and Its Behaviour in Model Activated Sludge Plants,
W87-09269 5D

Degradation of Aniline and Chloroanilines by Sunlight and Microbes in Estuarine Water,
W87-09271 5B

Kinetics and Mechanisms of Hypochlorite Oxidation of alpha-Amino Acids at the Time of Water Disinfection (Cinetiques et Mechanismes de l'Action Oxydative de l'Hypochlorite sur les Acides alpha-Amines lors de la Desinfection des Eaux),
W87-09274 5F

Fundamentals of Aquatic Toxicology: Methods and Applications.
W87-09280 5C

Pesticides,
W87-09291 5C

Biotransformation,
W87-09297 5B

Fate Modeling,
W87-09298 5B

Chemical Safety Evaluation,
W87-09301 5B

Response of Marine Animals to Petroleum and Specific Petroleum Hydrocarbons,
W87-09308 5C

Petroleum Spills in the Marine Environment: The Chemistry and Formation of Water-in-Oil Emulsions and Tar Balls,
W87-09339 5B

Fate of Some Components of Acidic Deposition in Ombrotrophic Mires,
W87-09382 5B

Biodegradation of Trichloroethylene and Involvement of an Aromatic Biodegradative Pathway,
W87-09387 5D

Leaching Behaviors of Low-Sulfur Coals and Coal Wastes from Three Western Coal Preparation Plants,
W87-09429 5B

LLNL Groundwater Quality: Sampling of Seven Shallow Wells on the LLNL Site,
W87-09458 5B

Vulnerability of Selected Lakes and Streams in the Middle Atlantic Region to Acidification: A Regional Survey,
W87-09476 5B

1984 Annual Report to the President and Congress: National Acid Precipitation Assessment Program.
W87-09479 5B

Field Survey of Heavy Metal Uptake by Naturally Occurring Saltwater and Freshwater Marsh Plants,
W87-09490 5B

Water-Quality Monitoring at the Hoe Creek Test Site: Review and Preliminary Conclusions,
W87-09495 5B

Suspended Particulate Matter in Commencement Bay,
W87-09498 2J

FAUNA
Effects of the Ixtoc I Oil Spill on the Intertidal and Subtidal Infaunal Populations Along Lower Texas Coast Barrier Island Beaches,
W87-09556 5C

FEASIBILITY STUDIES
Small-Scale Hydroelectric Power.
W87-09110 6A

FENITROTHION
Comparative Metabolism of Fenitrothion in Aquatic Organisms: I. Metabolism in the Euryhaline Fish, Oryzias latipes and Mugil cephalus,
W87-08859 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: II. Metabolism in the Freshwater Snails, Cipangopaludina japonica and Physa acuta,
W87-08860 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: III. Metabolism in the Crustaceans, Daphnia pulex and Palaemon paucidens,
W87-08861 5B

FENTHION
Field Confirmation of a Laboratory-Derived Hazard Assessment of the Acute Toxicity of Fenthion to Pink Shrimp, Penaeus duorarum,
W87-08638 5C

FENTIN ACETATE
Acute Toxicity of Brestan and Fentin Acetate on Some Freshwater Organisms,
W87-08876 5C

FERMENTATION
Scale-Up Experience with the Waterloo SCP Process in Industrial Biomass Waste Treatment,
W87-09455 5D

FERTILIZATION
Effect of Fertilization with Municipal Sludge on the Glutathione, Polyamine, and Cadmium Content of Cole Crops and Associated Loopers (Trichoplusia ni),
W87-08835 5C

FERTILIZERS
Influence of Long Term Cultural Operations on Physical and Water Retention Characters of a Red Sandy Loam Soil,
W87-08773 2G

Volatilization Loss of Nitrogen from Submerged Saline Soil,
W87-08892 2G

FEWA
Predictive Application of an ORNL Geohydrology Model,
W87-08760 7C

FIELD CAPACITY
Variation of the Subsoil Hydraulic Conductivities of Some New Zealand Soils with Changes in Water Tension,
W87-08736 2G

FIELD TESTS
Field Confirmation of a Laboratory-Derived Hazard Assessment of the Acute Toxicity of Fenthion to Pink Shrimp, Penaeus duorarum,
W87-08638 5C

Estimating Water Table Contribution to the Water Supply of Maize,
W87-08740 3F

Bare Soil Evaporation Near a Surface Point-Source Emitter,
W87-08743 2D

Distribution Coefficient of Trichloroethylene in Soil-Water Systems,
W87-08752 5B

Comparison of Field and Laboratory Methods for Determining Contaminant Flow Parameters,
W87-08757 5B

Bacteria as Structuring Agents in Lakes: Field Manipulations with Bacterioplankton,
W87-08768 2H

Leaf Thickness and Water Deficit in Plants: A Tool for Field Studies,
W87-08847 2D

Field Validation,
W87-09300 7A

FILTERS
Spectrophotometric Determination of Traces of Silicon in Water after Collection as Silicomolybdenum Blue on an Organic-Solvent-Soluble Membrane Filter,
W87-08833 5A

Riparian Areas as Filters for Agricultural Sediment,
W87-09002 4A

Statistical Structure and Filter Characteristics of Tritium Fluctuations in Fractured Basalt,
W87-09027 5B

Expansion of Granular Filters During Backwashing,
W87-09371 5D

Comparison of Backwash Models for Granular Media,
W87-09372 5D

FILTRATION
Cooperative Solution for a Water System 'Emergency',
W87-08807 5F

Anaerobic Treatment of Distillery Slops Using an Upflow Anaerobic Filter Reactor,
W87-08890 5D

Operational Variables and the Release of Colonized Granular Activated Carbon Particles in Drinking Water,
W87-08957 5F

Overview of Point-of-Use Water Treatment Technology,
W87-09119 5F

Optimal Water Treatment Plant Design,
W87-09374 5F

Factors of Scale in Rapid Sand Filtration,
W87-09440 5F

Importance of Laboratory Scale Study for the Design of Mobile-Bed Filter,
W87-09442 5F

Unique Pre-Ozonation - D.E. Filtration Water Treatment Plant Design is Based on Pilot Plant Data,
W87-09443 5F

Development of a New Type of Fluidized Bed Reactor,
W87-09444 5D

Scale-Up of Direct Filtration (The Wahnbach System),
W87-09447 5F

FINANCING
Innovative State Policies for Aiding Community Water Suppliers,
W87-08951 5F

FINITE ELEMENT ANALYSIS
Finite Element Analysis of Water Flow in Variably Saturated Soil,
W87-08620 2G

FINITE ELEMENT METHOD
Introduction to Groundwater Modeling: Finite Difference and Finite Element Methods,
W87-08684 2F

FINLAND
Dredging of Rapids for Timber-Floating in Finland and Its Effects on River-Spawning Fish Stocks,
W87-09045 6G

Restoration of the River Vaikkojoki, Finland,
W87-09046 2H

Whitefish and Vendace Stocks in the Regulated Lake Pyhajarvi, Central Finland,
W87-09052 2H

Water Level Regulation of Lake Inari: Impacts and Compensation Measures,
W87-09053 2H

Development of Fish Stock and Fish Populations in Lake Inari,
W87-09054 2H

Food of Whitefish (Coregonus lavaretus) in Two Neighbouring Lakes, One Regulated and the Other Natural,
W87-09055 2H

Fish Stocks and Fishing in the Lokka and Porttipahta Reservoirs, Northern Finland,
W87-09056 2H

FISH
Comparison of QSAR Predictions with Fish Toxicity Screening Data for 110 Phenols,
W87-08637 5C

Time/Toxicity Relationships in Short-Term Static, Dynamic, and Plug-Flow Bioassays,
W87-08639 5C

Measuring Fish Lengths from Instant Photographs Using a Digitizing Tablet and Minicomputer,
W87-08649 7B

Predation Risk and Use of Intertidal Habitats by Young Fishes and Shrimp,
W87-08787 2L

Comparison of Parasite Fauna of Juvenile Sockeye Salmon (Oncorhynchus Nerka) from Southern British Columbian and Washington State Lakes,
W87-08792 2H

Salinity During Embryonic Development Influences the Response to Salinity of Gasterosteus Aculeatus L. (Trachurus),
W87-08793 2H

Limits of Bioaccumulation of Organic Pigments in Fish: Their Relation to the Partition Coefficient and the Solubility in Water and Octanol,
W87-08853 5B

Effects of Lowered Dissolved Oxygen Concentration on the Toxicity of 1,2,4-Trichlorobenzene to Fathead Minnows,
W87-08879 5C

Organochlorine Pesticide Residues in Fish from the Shatt al-Arab River, Iraq,
W87-08880 5B

Acute Toxicity of Emulsifiable Concentrations of Three Insecticides Commonly Found in Nonpoint Source Runoff into Estuarine Waters to the Mummichog, Fundulus heteroclitus,
W87-08881 5C

Research in Environmental Pollution: II. Determination of Polychlorinated Nitrobenzenes (PCNB's) in Main River Fish,
W87-08895 5A

Contamination of Fish from the French Zone of Lake Leman by Organochlorine Compounds between 1973 and 1981 (Contamination des Poissons du Secteur Francais du Lac Leman, par les Composes Organochlores entre 1973 et 1981),
W87-08909 2H

Residues of Organochlorine Pesticides in Environmental Samples from the Shatt-al-Arab River, Iraq,
W87-08910 5B

FISH BEHAVIOR
Lake Effect on Stream Living Brown Trout (Salmo trutta),
W87-08763 2H

Swimming Performance of Fishes Endemic to the Missouri River in South Dakota,
W87-09496 8I

FISH CATCH
Ecological and Statistical Prognosis of the Dynamics of Fish Catch Based on Dendrochronological Data,
W87-08711 2H

FISH EGGS
Effects of Low Ambient pH on Perivitelline Fluid of Ambystoma maculatum (Shaw) Eggs,
W87-08963 5C

FISH LADDERS
Natural Propagation and Habitat Improvement - Washington, Volume IIA - Tumwater Falls and Dryden Dam Fish Passage.
W87-09109 8I

FISH MANAGEMENT
Quantitative and Qualitative Aspects of Fish Crop in Relation to Environmental Quality,
W87-08855 5C

Whitefish and Vendace Stocks in the Regulated Lake Pyhajarvi, Central Finland,
W87-09052 2H

Fish Diversion in Hydropower Intake,
W87-09197 8I

Swimming Performance of Fishes Endemic to the Missouri River in South Dakota,
W87-09496 8I

Focus: Fisheries Oceanography Cooperative Users System,
W87-09500 7C

FISH MIGRATION
Assessment of the Flow Requirements for Upstream Migration of Salmonids in Some Rivers of North-West England,
W87-09058 2H

Spring and Summer Movements of Subadult Striped Bass, Morone saxatilis, in the Connecticut River,
W87-09253 2H

Swimming Performance of Fishes Endemic to the Missouri River in South Dakota,
W87-09496 8I

FISH PASSAGES
Fish Diversion in Hydropower Intake,
W87-09197 8I

FISH PHYSIOLOGY
Salinity During Embryonic Development Influences the Response to Salinity of Gasterosteus Aculeatus L. (Trachurus),
W87-08793 2H

Effect of Ingested Benzo(a)pyrene and Cadmium on Tissue Accumulation, Hydroxylase Activity, and Intestinal Morphology of the Black Sea Bass, Centropristis striata,
W87-08842 5C

Lead Nitrate Induced Changes in the Thyroid Physiology of the Catfish Clarias batrachus (L),
W87-08850 5C

Impact of Pesticides on Lipid Metabolism in the Freshwater Catfish, Clarias batrachus, during the Vitellogenic Phase of Its Annual Reproductive Cycle,
W87-08851 5C

Xenobiotic-Metabolizing Enzyme Systems in Test Fish: I. Comparative Studies of Liver Microsomal Monooxygenases,
W87-08852 5C

Long-Term Effects of Bleached Kraft Mill Effluents on Carbohydrate Metabolism and Hepatic Xenobiotic Biotransformation Enzymes in Fish,
W87-08854 5C

Influence of Cadmium Exposure on Selected Hematological Parameters in Freshwater Teleost, Notemigonus crysoleucas,
W87-08857 5C

Pesticide-Induced Changes in Peripheral Thyroid Hormone Levels during Different Reproductive Phases in Heteropneustes fossilis,
W87-08858 5C

Comparative Metabolism of Fenitrothion in Aquatic Organisms: I. Metabolism in the Euryhaline Fish, Oryzias latipes and Mugil cephalus,
W87-08859 5B

Biotransformation,
W87-09297 5B

FISH PONDS
Seasonal Distribution of Legionellae Isolated from Various Types of Water in Israel,
W87-08903 5A

FISH POPULATIONS
Quantitative and Qualitative Aspects of Fish Crop in Relation to Environmental Quality,
W87-08855 5C

Regulation of Riverine Fish Communities by a Continuum of Abiotic-Biotic Factors,
W87-09037 2H

Fall of Migratory Fish Populations and Changes in Commercial Fisheries in Impounded Rivers in Poland,
W87-09039 6G

Effects of Impoundment and Regulation of the River Tees at Cow Green (Northern Pennines, UK) Upon Fish Populations in Afferent Tributaries and in the River Immediately Downstream of the Dam,
W87-09040 6G

Review of Effects of Environmental Degradation on the Freshwater Stages of Anadromous Fish,
W87-09042 2H

Dredging of Rapids for Timber-Floating in Finland and Its Effects on River-Spawning Fish Stocks,
W87-09045 6G

Physical and Biological Effects of Gravel Extraction in River Beds,
W87-09049 4C

Development of Fish Stock and Fish Populations in Lake Inari,
W87-09054 2H

Fish Stocks and Fishing in the Lokka and Porttipahta Reservoirs, Northern Finland,
W87-09056 2H

Introduction of Mysis relicta in Sweden: Effects on Fish in Impounded Lakes,
W87-09057 2H

Physical Structure and Brown Trout (Salmo trutta fario) Populations in Small Danish Lowland Streams,
W87-09059 2H

Effect of Recreational Uses Upon Aquatic Ecosystems and Fish Resources,
W87-09060 6G

FISH PREDATION
Fish Predation on Juvenile Brown Shrimp, Penaeus Aztecus Ives: Effects of Turbidity and Substratum on Predation Rates,
W87-09252 2H

FISH STOCKING
Fish Stocks and Fishing in the Lokka and Porttipahta Reservoirs, Northern Finland,
W87-09056 2H

FISHERIES
Quantitative and Qualitative Aspects of Fish Crop in Relation to Environmental Quality,
W87-08855 5C

Cadmium Contamination in American Lobster, Homarus americanus, Near a Coastal Lead Smelter: Use of Multiple Linear Regression for Management,
W87-08882 5C

Habitat Modification and Freshwater Fisheries.
W87-09036 4C

Effects on Fisheries of Non-Biotic Modifications of the Environment in the East-Danube River Area,
W87-09038 6G

Adverse Effects of Channelization and Their Amelioration,
W87-09043 6G

Role of the Fisheries Engineer in the Design and Execution of Arterial Drainage Schemes,
W87-09044 8I

Ameliorative Methods to Reinstate Fisheries Following Land Drainage Operations,
W87-09048 6G

Effect of Habitat Modification on Freshwater Fisheries in Lowland Areas of Eastern England,
W87-09050 2H

Afforestation and Fisheries,
W87-09061 4C

Focus: Fisheries Oceanography Cooperative Users System,
W87-09500 7C

FISHERY DATA
Focus: Fisheries Oceanography Cooperative Users System,
W87-09500 7C

FISSURED AQUIFERS
Unsteady Flow to Wells in Layered and Fissured Aquifer Systems,
W87-08618 2F

FLOCCULATION
Laboratory Determination of Dispersant Effectiveness: Method Development and Results,
W87-09509 5G

Biodegration of Chemically Dispersed Crude Oil,
W87-09512 5B

FLOOD CONTROL
Optimization of Closure Operations in a Tidal Basin During a Storm-Surge,
W87-08610 4A

Counting the Days Along Lake Michigan,
W87-08804 2J

New Procedures for Flood Estimation in Norway,
W87-08811 2E

Design of Spillway Crests,
W87-09195 8A

FLOOD DAMAGE
Counting the Days Along Lake Michigan,
W87-08804 2J

Flood Damage Model for Flood Plain Studies,
W87-08965 2E

FLOOD ESTIMATION
New Procedures for Flood Estimation in Norway,
W87-08811 2E

FLOOD FREQUENCY
Generalized Method of Moments as Applied to Problems of Flood Frequency Analysis: Some Practical Results for the Log-Pearson Type 3 Distribution,
W87-08616 2E

FLOOD IRRIGATION
Surge Irrigation Management,
W87-08744 3F

FLOOD PLAIN MANAGEMENT
Flood Damage Model for Flood Plain Studies,
W87-08965 2E

FLOOD PROTECTION
Optimization of Closure Operations in a Tidal Basin During a Storm-Surge,
W87-08610 4A

FLOODING
Effects of Flooding, Tilting of Stems, and Ethrel Application on Growth, Stem Anatomy and Ethylene Production of Pinus Densiflora Seedlings,
W87-08797 2I

Counting the Days Along Lake Michigan,
W87-08804 2J

New Procedures for Flood Estimation in Norway,
W87-08811 2E

Volatilization Loss of Nitrogen from Submerged Saline Soil,
W87-08892 2G

Artificial Ground Water Recharge by Flooding During Grapevine Dormancy,
W87-08979 2F

Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XI. Growth of Geum rivale L. and Geum urbanum L. and Soil Chemical Condition in Experimentally Flooded Soil,
W87-09398 2I

Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XII. Growth, Photosynthetic Capacity and Metal Ion Uptake in Salix caprea and S. Cinerea ssp. Oleifolia,
W87-09399 2I

Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XIII. The Effect of Fe(2+) on Photosynthesis and Respiration of Salix caprea and S. cinerea ssp. oleifolia,
W87-09400 2I

Effect of Waterlogging on Infection of Eucalyptus marginata Seedlings by Phytophthora cinnamomi,
W87-09401 2I

Changes at Panicle Emergence in the Water Relations of a Wetland and a Dryland Japonica Rice Cultivar Under Wetland Conditions,
W87-09415 2I

Water Control Strategy of Mines Under Strong Karstic Water Hazard,
W87-09600 4B

FLOODS
New Procedures for Flood Estimation in Norway,
W87-08811 2E

Extreme Floods in Southern Africa Caused by Tropical Cyclone Domoina,
W87-09410 2F

FLOODWAVE RESPONSE
Diffusivity of a Glacial-Outwash Aquifer by the Floodwave-Response Technique,
W87-08754 2F

FLORIDA
Humic Substances in Groundwater,
W87-09070 2F

Atmospheric Deposition of Nitrogen and Phosphorus in Florida,
W87-09175 5B

Importance of Atmospheric Fluxes to the Nitrogen Balance of Lakes in the Florida Peninsula,
W87-09176 2H

Atmospheric Deposition of Acidity and Sulfur in Florida,
W87-09177 5B

FLOTATION
Wastewater Treatment System Applying Aeration-Cavitation Flotation Mechanism,
W87-08603 5D

FLOW
Reverse Pathline Calculation of Time-Related Capture Zones in Nonuniform Flow,
W87-08753 2F

Hydrodynamics and Structure: Interactive Effects on Meiofauna Dispersal,
W87-08838 2L

FLOW CHARACTERISTICS
River Flow with Excessive Suspended Sediment Load: An Evaluation of Turbulent Flow Characteristics,
W87-08826 2E

Lateral Outflow over Side Weirs,
W87-09196 8A

FLOW DISCHARGE
Temperature and Flow Conditions in a Reservoir with a Submerged Outlet Tunnel During the Winter Period,
W87-08828 2H

Low Discharge Periods of Rivers in the Upper Vistula River Basin, Poland,
W87-08970 7B

FLOW MODELS
Computation of Unsteady Flows in the Alabama River,
W87-08980 2E

Mobilization of Aluminum in a Natural Soil System: Effects of Hydrologic Pathways,
W87-09024 5B

Modeling the Flow of Immiscible Fluids in Soils,
W87-09258 2G

FLOW RATES
Assessment of the Flow Requirements for Upstream Migration of Salmonids in Some Rivers of North-West England,
W87-09058 2H

FLOW VELOCITY
Swimming Performance of Fishes Endemic to the Missouri River in South Dakota,
W87-09496 8I

FLUID MECHANICS
Perspectives on the Scale-Up of Impeller Mixers,
W87-09434 5D

FLUIDIZATION
Expansion of Granular Filters During Backwashing,
W87-09371 5D

Comparison of Backwash Models for Granular Media,
W87-09372 5D

FLUIDIZED BEDS
Importance of Laboratory Scale Study for the Design of Mobile-Bed Filter,
W87-09442 5F

Development of a New Type of Fluidized Bed Reactor,
W87-09444 5D

FLUORANTHENE
Short-Term Effects of Polynuclear Aromatic Hydrocarbons on Sea-Surface Microlayer Phytoneuston,
W87-09238 5C

FLUORESCENCE
Theory of Fluorescent Irradiance Fields in Lakes and Seas,
W87-09193 5A

Use of Monodispersed, Fluorescently Labeled Bacteria to Estimate In Situ Protozoan Bacterivory,
W87-09388 2H

FLUORIDES
Epidemiology of Dental Caries in Relation to Environmental Trace Elements,
W87-08694 5C

Absence of Mutagenic and Antimutagenic Activities of Fluoride in Ames Salmonella Assays,
W87-09405 5C

FLUVIAL HYDROLOGY
Fluvial Hydrology,
W87-08685 2A

FLY ASH
Removal of Phenols by Adsorption on Fly Ash,
W87-09250 5D

Physical and Chemical Behavior and Environmental Acceptability of Stabilized Scrubber Sludge and Fly Ash in Seawater,
W87-09327 5B

FOG
Pesticides in Fog,
W87-09229 5B

FOOD CHAINS
Investigation into the Retention of 65Zn Absorbed by the Trophic Pathway in Cyprinus Carpio L. Influence of the Ingestion Frequency and the Radiozinc Content of Food (Etude de la Retention Du 65Zn Absorbe par voie Trophique Chez Cyprinus Carpio L. Influence du Rythme D'Ingestion et de la Teneur en Radiozinc de la Nourriture),
W87-09268 5B

FOOD CROPS
Effects of Water Stress on Flowering and Fruit Set in Processing-Tomatoes,
W87-08770 2I

FOOD HABITS
Brood Size and Neonate Weight of Daphnia magna Produced by Nine Diets,
W87-08641 2H

Effects of Food Availability and Fish Predation on a Zooplankton Community,
W87-08799 2H

Sestonic Bacteria as a Food Source for Filtering Invertebrates in Two Southeastern Blackwater Rivers,
W87-08870 2H

Immunological Dietary Analysis of Two Penaeid Shrimp Species from a South Carolina Tidal Creek,
W87-08988 2L

Feeding Reduction and Recovery in Cunner Tautogolabrus adspersus Following Exposure to Crude Oil,
W87-09239 5C

Fish Predation on Juvenile Brown Shrimp, Penaeus Aztecus Ives: Effects of Turbidity and Substratum on Predation Rates,
W87-09252 2H

Scanning Currents in Stokes Flow and the Efficient Feeding of Small Organisms,
W87-09385 2H

Use of Monodispersed, Fluorescently Labeled Bacteria to Estimate In Situ Protozoan Bacterivory,
W87-09388 2H

FOOD-PROCESSING WASTES
Anaerobic Treatment of Distillery Slops Using an Upflow Anaerobic Filter Reactor,
W87-08890 5D

FORAGES
Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: I. Persistence, Yield, Quality, and Elemental Removal,
W87-08919 5C

Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: II. Rainfall Runoff and Soil Chemical Properties,
W87-08920 5C

FORECASTING
Operational Spring Time Forecasting Difficulties and Improvements,
W87-08824 2E

Climate Forecast Verifications, U.S. Mainland, 1974-82,
W87-09499 2B

Forecasting the Rates of Water Inflowing into Mines,
W87-09599 2F

FOREST HYDROLOGY
Estimation of Canopy Reservoir Capacity and Oxygen-18 Fractionation in Throughfall in a Pine Forest,
W87-08814 2B

FOREST MANAGEMENT
Pasture and Forest Management in the Mediterranean Uplands,
W87-08665 3F

FOREST SOILS
Forest Soil Organic Horizon Acidification: Effects of Temperature, Time, and Solution/Soil Ratio,
W87-09009 2G

FOREST WATERSHEDS
Simulation of the Hydrologic Cycle for Watersheds,
W87-09111 2A

FORESTS
Chemistry of Tension Lysimeter Water and Lateral Flow in Spruce and Hardwood Stands,
W87-08926 5B

Dynamics of Sulfate Retention by Acid Forest Soils in an Acidic Deposition Environment,
W87-09008 5B

FOUNDATION TREATMENT
Foundation Treatment Using Pneumatically Applied Concrete,
W87-09158 8F

FOUNDATIONS
Seepage Regime in the Foundation of the Kanev Hydroelectric Station,
W87-09364 8D

FRACTIONATION
Fractionation of Soil Humic Substances,
W87-09081 2G

Fractionation Techniques for Aquatic Humic Substances,
W87-09082 7B

FRACTURED BASALT
Statistical Structure and Filter Characteristics of Tritium Fluctuations in Fractured Basalt,
W87-09027 5B

FRANCE
Recent Developments in the Treatment of Drinking Water with Ozone,
W87-09146 5F

Groundwater Management in France,
W87-09205 2F

FRESHWATER
Salinity During Embryonic Development Influences the Response to Salinity of Gasterosteus Aculeatus L. (Trachurus),
W87-08793 2H

FRESHWATER LAKES
Absorption of Light by Yellow Substance in Freshwater Lakes,
W87-08934 2H

FRESNO RESERVOIR
Cultural Resource Inventory of Fresno Reservoir, Hill County, Montana,
W87-09331 6G

FROGS
Growth and Development of Rana arvalis in Conditions Imitating Oil Contamination,
W87-08713 5C

Use of Bullfrogs (Rana catesbeiana) as Biological Markers for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin Contamination in the Environment,
W87-08733 5A

Lethal Effects of Diquat and Paraquat on Developing Frog Embryos and 15-Day-Old Tadpoles, Rana pipiens,
W87-09235 5C

FRONTIERS
Rainfall Pattern Associated with a Split Cold Front as Seen on FRONTIERS,
W87-08800 2B

FROST
Point Probability Distributions of Frozen Soil,
W87-08696 2C

Conditions for Crack Propagation by Frost Wedging,
W87-09350 2C

FROZEN GROUND
Point Probability Distributions of Frozen Soil,
W87-08696 2C

FUEL
Response to the Esso Bayway Oil Spill,
W87-09549 5G

Impacts of a Spill of No. 6 Fuel Oil on Lake Winona,
W87-09551 5C

FULVIC ACIDS
Geochemistry of Stream Fulvic and Humic Substances,
W87-09073 2H

FUNGI
Water Relations of Xeric Grasses in the Field: Interactions of Mycorrhizzas and Competition,
W87-09341 2I

FURROW EROSION
Control of Furrow Erosion With Crop Residues and Surge Flow Irrigation,
W87-09003 3F

FURROW IRRIGATION
Surge Irrigation Management,
W87-08744 3F

FUTURE PLANNING
Low Freshwater Inflow Study: Chesapeake Bay Hydraulic Model Investigation,
W87-09484 2L

GAGING STATIONS
Data Collection and Instrumentation,
W87-09103 7B

GALE
Canadian Atlantic Storms Program: The Meteorological Field Project,
W87-09255 2B

GALERKIN TECHNIQUE
Simulation of the Borden Plume Using the Alternating Direction Galerkin Technique,
W87-09030 5B

GALLOTANNIC ACID
Methanogenic Toxicity and Anaerobic Degradability of a Hydrolyzable Tannin,
W87-09278 5D

GAMMARUS
Digestion of Carbohydrates and Protein by Gammarus mucronatus Say (Amphipoda),
W87-08839 2L

GANGES RIVER
Nature of Organic Matter in Rivers with Deep Sea Connections: The Ganges-Brahmaputra and Indus,
W87-08721 2H

Heavy Metals Distribution in the Sediments of Ganges and Brahmaputra Rivers,
W87-09204 5B

GAS CHROMATOGRAPHY
Gas Chromatographic Analysis of Volatile Compounds in Water and Biological Samples with an Automatic Injector,
W87-09012 7B

GAS EXCHANGE
Role of Gas Exchange in the Inorganic Carbon, Oxygen, and 222Rn Budgets of the Amazon River,
W87-08871 2H

Exchange of Particles and Gases Across Water Surfaces,
W87-09168 5B

Responses of Gas Exchange to Humidity in Populations of Three Herbs from Environments Differing in Atmospheric Water,
W87-09346 2I

Effects of Water Stress on Gas Exchange and Water Relations of Succulent Epiphyte, Kalanchoe Uniflora,
W87-09347 2I

Leaf Photosynthesis and Conductance of Selected Triticum Species at Different Water Potentials,
W87-09419 2I

GAS RELEASE
1986 Lake Nyos Gas Disaster in Cameroon, West Africa,
W87-08780 2H

GASES
Transfer Rates of Gaseous Pollutants Between the Atmosphere and Natural Waters,
W87-09167 5B

GATES
Programmed Closing of Gates Upon Loss of Drive by a Pump Unit,
W87-09355 8C

GELS
Analysis of Pentachlorophenol in Water and Urine by Enrichment with Lipidex(R) 5000,
W87-08896 5A

GENERATORS
Measures to Reduce the Level of Vibrations of Turbine-Generator Units,
W87-09365 8C

GENOTYPES
Maintenance and Stability of Introduced Genotypes in Groundwater Aquifer Material,
W87-09391 5B

GEOCARCINOGENS
Possible Influence of the Components of the Soil and Lithosphere on the Development and Growth of Neoplasms,
W87-08693 2K

GEOCHEMISTRY
Geochemistry, Soils and Cardiovascular Diseases,
W87-08692 2F

Possible Influence of the Components of the Soil and Lithosphere on the Development and Growth of Neoplasms,
W87-08693 2K

Geochemical Partitioning of Heavy Metals in Sediments of Three Estuaries Along the Coast of Rio de Janeiro (Brazil),
W87-08717 2L

Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization.
W87-09067 2H

Geochemistry of Soil Humic Substances,
W87-09068 2J

Geochemistry of Humic Substances in Natural and Cultivated Peatlands,
W87-09069 2H

Geochemistry and Ecological Role of Humic Substances in Lakewater,
W87-09071 2H

Geochemistry of Humic Substances in Lake Sediments,
W87-09072 2H

Geochemistry of Stream Fulvic and Humic Substances,
W87-09073 2H

Geochemistry of Humic Substances in Estuarine Environments,
W87-09074 2H

Geochemistry of Humic Substances in Seawater,
W87-09075 2L

Geochemistry of Humic Substances in Marine Sediments,
W87-09076 2J

Geochemistry of Humin,
W87-09077 2H

Yakima River Basin Historical Resource Survey, Volume I: Overview and Management Recommendations,
W87-09192 6G

Geochemical Studies in the Drainage Basin of the Rio Vouga, Portugal. IV. Impact of Land Use on the Hydrogeochemistry of Natural Waters in the Vouzela Region,
W87-09207 4C

Seasonal Effects on Ground-Water Chemistry of the Ouachita Mountains,
W87-09428 2K

Orientation Study of St. Francois Mountain and Decaturville Precambrian Areas, Missouri,
W87-09459 2K

GEOGRAPHIC INFORMATION SYSTEM
Geographic Information System to Predict Non-Point Source Pollution Potential,
W87-08977 7A

GEOHYDROLOGY
Groundwater Engineering,
W87-08687 2F

Predictive Application of an ORNL Geohydrology Model,
W87-08760 7C

Hydrology, Water Chemistry and Ecological Relations in the Raised Mound of Cowles Bog,
W87-08837 2H

Hydrogeological Aspects of Agricultural Drainage in Ireland,
W87-09203 2E

Role of Hydrogeology in Coal Mining Near Chandrapur in Maharashtra, India,
W87-09569 2F

Hydrogeology of Underground Coal Mines in Illinois,
W87-09573 2F

Hydrogeological Problems Affecting the Exploitation of the Peat Bog at Padul (Granad, Spain). Preliminary Study (Problemas Hidrogeologicos que Afectan a la Explotacion de la Turbera de Padul (Granad, Espana). Estudio Preliminar),
W87-09576 4A

Influence of Underground Engineering Works on Hydrogeological Conditions of the Suburban Areas,
W87-09581 2F

British Examples of a Hydrogeological Approach to the Evaluation of Drainage Problems in Subsurface Engineering,
W87-09593 2F

Piezometric Level in Fissure Areas (Le Niveau Piezometrique dans les Zones de Diaclases),
W87-09601 2F

GEOLOGIC FRACTURES
Piezometric Level in Fissure Areas (Le Niveau Piezometrique dans les Zones de Diaclases),
W87-09601 2F

GEOMORPHOLOGY
Shifting of the Kosi River, Northern India,
W87-08834 2E

Geomorphological Alteration of a Heavily Oiled Saltmarsh (Ile Grande, France) as a Result of Massive Cleanup,
W87-09543 5B

GEORGIA
Geochemistry of Stream Fulvic and Humic Substances,
W87-09073 2H

Establishment of Biotic Communities Within a Newly Constructed Ash Settling Basin and Its Drainage System,
W87-09323 5E

GEOTHERMAL POWER
Geothermal Reservoir Engineering Experience in Iceland,
W87-08830 6G

GEOTHERMAL RESOURCES
Geothermal Reservoir Engineering Experience in Iceland,
W87-08830 6G

GEOTHERMAL STUDIES
Geothermal Reservoir Engineering Experience in Iceland,
W87-08830 6G

GERMINATION
Effects of Distillery Waste on the Performance of Cicer arietinum L.,
W87-08873 5C

Effects of Simulated Acidic Mist on Germination of Alternaria solani and Phytophthora infestans in vitro and their Infection Efficiency and Sporulation on Potato,
W87-09414 5C

GEUM
Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XI. Growth of Geum rivale L. and Geum urbanum L. and Soil Chemical Condition in Experimentally Flooded Soil,
W87-09398 2I

GIARDIA
Concentration of Giardia Cysts from Water by a Centrifugal Cream Separator,
W87-09209 5A

GILA RIVER
Coolidge Dam: Photographs Written Historical and Descriptive Data Reduced Copies of Drawings,
W87-09163 8A

GIRONDE ESTUARY
Concentrations of Mercury in Near Shore Surface Waters of the Bay of Biscay and in the Gironde Estuary,
W87-08961 5A

GLACIERS
Subglacial Drainage for an Ice Sheet Resting Upon a Layered Deformable Bed,
W87-09248 2F

GLACIOHYDROLOGY
Subglacial Drainage for an Ice Sheet Resting Upon a Layered Deformable Bed,
W87-09248 2F

GLASS
Leaching Radioactive and Nonradioactive Elements from Actual Savannah River Plant Nuclear Waste Glass,
W87-09112 5B

GLUCOSE
Influence of Cadmium Exposure on Selected Hematological Parameters in Freshwater Teleost, Notemigonus crysoleucas,
W87-08857 5C

GLUTATHIONE
Effect of Fertilization with Municipal Sludge on the Glutathione, Polyamine, and Cadmium Content of Cole Crops and Associated Loopers (Trichoplusia ni),
W87-08835 5C

Glutathione Status and Protein Synthesis During Drought and Subsequent Rehydration in Tortula ruralis,
W87-09417 2I

GOLD MINING
Transport of Arsenic and Mercury from Gold Mining Activities Through an Aquatic System,
W87-08731 5B

GRAIN CROPS
Irrigation in India: A Physiological and Phenological Approach to Water Management in Grain Crops,
W87-09468 3F

GRANULAR FILTERS
Expansion of Granular Filters During Backwashing,
W87-09371 5D

Comparison of Backwash Models for Granular Media,
W87-09372 5D

GRAPEVINES
Artificial Ground Water Recharge by Flooding During Grapevine Dormancy,
W87-08979 2F

GRASSES
Laboratory Experiment on the Role of Grass for Infiltration and Runoff Processes,
W87-08622 2A

Establishing Smooth Cordgrass in Tidal Wetlands,
W87-08806 2I

Spatial Variability of Soil Water and Evapotranspiration,
W87-08815 2G

Mineral Content of Grasses and Grasslands of the Himalayan Region: 2. Concentration of Trace and Major Elements in Grasses in Relation to Soil Properties and Climatic Factors,
W87-09256 2I

GRAVEL
Physical and Biological Effects of Gravel Extraction in River Beds,
W87-09049 4C

GRAVITY DRAINAGE
Gravity Drainage Analysis for Scale Heterogeneous Porous Materials Under Falling Water Table Conditions,
W87-09020 2G

GREAT LAKES
Model for Estimating the Loading Rate of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin to the Great Lakes,
W87-08660 5B

Air/Water Exchange Coefficients,
W87-08679 5B

Atmospheric Pollutants in Natural Waters.
W87-09164 5B

GREECE
Correlation of Some Organic Pollution Factors in Water Systems in Northern Greece,
W87-09264 5B

GREENLAND
Seasonal and Spatial Trends in South Greenland Snow Chemistry,
W87-08946 5B

Scavenging of Atmospheric Sulfate by Arctic Snow,
W87-08947 2C

GROUNDWATER
Groundwater Engineering,
W87-08687 2F

Possible Influence of the Components of the Soil and Lithosphere on the Development and Growth of Neoplasms,
W87-08693 2K

Distribution Coefficient of Trichloroethylene in Soil-Water Systems,
W87-08752 5B

Predictive Application of an ORNL Geohydrology Model,
W87-08760 7C

Geologic Isolation of High-Level Radioactive Waste: Putting It Away Forever,
W87-08805 5E

Profiles of Nitrogen Species in a Sand-Silt Aquifer at Haslemoen, Solor, South Norway,
W87-08818 5B

Laboratory Experiments on Solute Transport in Non-Homogeneous Porous Media,
W87-08819 5B

Groundwater Modelling for Hydropower Development in Iceland,
W87-08829 2F

Association between Legionella pneumophila and Amoebae in Water,
W87-08906 5F

Water Quality Beneath Urban Runoff Water Management Basins,
W87-08967 2F

Statistical Structure and Filter Characteristics of Tritium Fluctuations in Fractured Basalt,
W87-09027 5B

Humic Substances in Groundwater,
W87-09070 2F

Occurence of Contamination In Drinking Water From Groundwater Sources,
W87-09125 5B

Perennial Pasture Production after Irrigation with Saline Groundwater in the Goulburn Valley, Victoria,
W87-09208 3C

Water Treatment: The States Zero in on Groundwater Regulation,
W87-09222 5F

Subglacial Drainage for an Ice Sheet Resting Upon a Layered Deformable Bed,
W87-09248 2F

Removal of Individual Off-Flavour Compounds in Water During Artificial Groundwater Recharge and During Treatment by Alum Coagulation/Sand Filtration,
W87-09267 5F

Distribution of Protozoa in Subsurface Sediments of a Pristine Groundwater Study Site in Oklahoma,
W87-09395 2H

Seasonal Effects on Ground-Water Chemistry of the Ouachita Mountains,
W87-09428 2K

LLNL Groundwater Quality: Sampling of Seven Shallow Wells on the LLNL Site,
W87-09458 5B

Orientation Study of St. Francois Mountain and Decaturville Precambrian Areas, Missouri,
W87-09459 2K

Contamination of Groundwater by Hydrocarbons from a Refinery - A Case History,
W87-09547 5G

GROUNDWATER CONTROL

Attempts to Determine the Viability of a Deep Excavation on the Coast of the Vandellos Massif (Tarragona, Spain) (Ensayos Para Determinar la Viabilidad de una Excavacion Profunda en el Litoral del Macizo de Vandellos (Tarragona, Expana)),
W87-09574 2F

GROUNDWATER HYDROLOGY

Hydrology, Water Chemistry and Ecological Relations in the Raised Mound of Cowles Bog,
W87-08837 2H

GROUNDWATER MANAGEMENT

Congressional Initiatives,
W87-09133 5G

Groundwater Resource Development,
W87-09148 6D

Groundwater Management in France,
W87-09205 2F

Irrigated Agriculture and Groundwater Quality--A Framework for Policy Development,
W87-09212 6A

Nonpoint Agricultural Pollution: Pesticide Contamination of Groundwater Supplies,
W87-09213 5B

Preliminary Hydrogeological Study of the Reocin Mine (Santander, Spain) (Estudio Hidrogeologico Preliminar de la Mina de Reocin (Santander, Espana)),
W87-09579 2F

Protection of the Karstic Springs System in Golubinka Against Contamination by the Sea Water (la Protection du Systeme des Sources Karstiques de Golubinka Contre la Contamination par la Mer),
W87-09582 4B

Groundwater Control in Opencast Mining of a Lignite Deposit in Southern Greece,
W87-09583 4B

Mine and Open Pit Dewatering at Chingola, Zambia,
W87-09584 4B

Influence of Underground Constructions in Crystalline Rock on Groundwater Conditions and the Use of Artificial Recharge to Restore a Lowered Piezometric Surface,
W87-09589 4B

Some Hydrogeological Solutions to the Exploitation of Underground Lignite Mines (Quelques Solutions Hydrogeologiques dans la Construction des Mines de Lignite Souterraines),
W87-09597 4B

Water Control Strategy of Mines Under Strong Karstic Water Hazard,
W87-09600 4B

GROUNDWATER MINING

Influence of Meltwater on the Amount and Composition of Groundwater in Quaternary Deposits in Finland,
W87-09460 2F

GROUNDWATER MONITORING

Water-Quality Monitoring at the Hoe Creek Test Site: Review and Preliminary Conclusions,
W87-09495 5B

GROUNDWATER MOVEMENT

Determination of Hydraulic Conductivity from Auger Holes and Pits - An Approximation,
W87-08617 2F

Unsteady Flow to Wells in Layered and Fissured Aquifer Systems,
W87-08618 2F

Finite Element Analysis of Water Flow in Variably Saturated Soil,
W87-08620 2G

Laboratory Experiment on the Role of Grass for Infiltration and Runoff Processes,
W87-08622 2A

Introduction to Groundwater Modeling: Finite Difference and Finite Element Methods,
W87-08684 2F

Groundwater Engineering,
W87-08687 2F

Reverse Pathline Calculation of Time-Related Capture Zones in Nonuniform Flow,
W87-08753 2F

Diffusivity of a Glacial-Outwash Aquifer by the Floodwave-Response Technique,
W87-08754 2F

Comparison of Field and Laboratory Methods for Determining Contaminant Flow Parameters,
W87-08757 5B

Impact of the Dupuit-Forchheimer Approximation on Salt-Water Intrusion Simulation,
W87-08758 2F

Performance and Analysis of Aquifer Tracer Tests with Implications for Contaminant Transport Modeling - A Project Summary,
W87-08759 5B

Laboratory Experiments on Solute Transport in Non-Homogeneous Porous Media,
W87-08819 5B

Groundwater Modelling for Hydropower Development in Iceland,
W87-08829 2F

Trees as Indicators of Subterranean Water Flow from a Retired Radioactive Waste Disposal Site,
W87-08845 5A

First-Order Reliability Approach to Stochastic Analysis of Subsurface Flow and Contaminant Transport,
W87-09017 5B

Capillarity Correction for Free Surface Flow of Groundwater,
W87-09018 2F

Statistical Structure and Filter Characteristics of Tritium Fluctuations in Fractured Basalt,
W87-09027 5B

Determining Optimum Pumping Rates for Creation of Hydraulic Barriers to Ground-Water Pollutant Migration,
W87-09108 5G

BASIC Hydraulics,
W87-09304 8B

Groundwater Transport: Handbook of Mathematical Models,
W87-09306 5B

Origin of Brine in the San Andres Formation, Evaporite Confining System, Texas Panhandle and Eastern New Mexico,
W87-09351 2F

Influence on the Groundwater Conditions in a Multilayered Aquifer System by Alum-Shale Mining,
W87-09570 5C

Influence of Structure on Underground Water Prediction and Occurrence at Rokana Mine, Kitwe, Zambia,
W87-09572 2F

Hydrogeology of Underground Coal Mines in Illinois,
W87-09573 2F

Proposed Hydrogeological Model for Future Lignite Mining and Groundwater Drainage in the Hula Basin, Northern Israel,
W87-09578 2F

Preliminary Hydrogeological Study of the Reocin Mine (Santander, Spain) (Estudio Hidrogeologico Preliminar de la Mina de Reocin (Santander, Espana)),
W87-09579 2F

Application of Isotope Techniques and Well Loggind in Investigating Ground Water Influenced by Mining,
W87-09580 2F

Influence of Underground Engineering Works on Hydrogeological Conditions of the Suburban Areas,
W87-09581 2F

Development of a Ground Water Hazard Map for an Underground Coal Mine,
W87-09585 2F

Origin and Dynamics of the Waters Flowing into the Mining Works in Reocin (Santander, Spain) (Sobre el Origen y Dinamica de las Aguas Fluyentes a las Explotaciones Mineras de Reocin (Santander, Espana)),
W87-09586 2F

Hydrogeological Aspects of Coal Mining Under Stored Waters Near Sydney, Australia,
W87-09587 2F

Water Hazard in Deep Gold Mining of the Far West Witwatersrand - South Africa,
W87-09588 2F

Plans and Experiments to Deal with Large Amounts of Sediment in Hungarian Mines under Karstic Water Hazard,
W87-09590 4C

Hydrogeological Aspects of Ground Water Inflow in the Juktan Tunnels, Sweden,
W87-09591 2F

British Examples of a Hydrogeological Approach to the Evaluation of Drainage Problems in Subsurface Engineering,
W87-09593 2F

System of Underground Water in a Karstic Country and the Tunnels Excavated for Water Transport to Athens (le Regime des Eaux Souterraines dans un Pays Karstique et les Galeries de la Grande Adduction d'Eau d'Athenes),
W87-09595 2F

Problems of Water Inrush into Greek Underground Mines with Special Emphasis to Sea Water Inrush Through Karstic Limestones or Impermeable Formations,
W87-09596 2F

Forecasting the Rates of Water Inflowing into Mines,
W87-09599 2F

Water Control Strategy of Mines Under Strong Karstic Water Hazard,
W87-09600 4B

Piezometric Level in Fissure Areas (Le Niveau Piezometrique dans les Zones de Diaclases),
W87-09601 2F

GROUNDWATER ORIGINS
Origin of Brine in the San Andres Formation, Evaporite Confining System, Texas Panhandle and Eastern New Mexico,
W87-09351 2F

GROUNDWATER POLLUTION
Monitoring Well Installation, Purging, and Sampling Techniques - Part 1: Conceptualizations,
W87-08755 7B

Performance and Analysis of Aquifer Tracer Tests with Implications for Contaminant Transport Modeling - A Project Summary,
W87-08759 5B

Geologic Isolation of High-Level Radioactive Waste: Putting It Away Forever,
W87-08805 5E

Stochastic Modelling of a Contaminated Aquifer: The Unconditional Approach,
W87-08820 5B

Growth of Mixed Microbial Populations in Ground Water Containing Highly Chlorinated Organic Wastes,
W87-08878 5B

Velocity Control as a Tool for Optimal Plume Containment in the Equus Beds Aquifer, Kansas,
W87-08982 5G

Groundwater-Leachate: Modeling/Monitoring/Sampling,
W87-09089 5B

Determining Optimum Pumping Rates for Creation of Hydraulic Barriers to Ground-Water Pollutant Migration,
W87-09108 5G

Occurence of Contamination In Drinking Water From Groundwater Sources,
W87-09125 5B

Improved Monitoring Techniques to Assess Groundwater Quality Near Sources of Contamination,
W87-09126 5A

Federal Protection of Groundwater,
W87-09129 5G

Nonpoint Agricultural Pollution: Pesticide Contamination of Groundwater Supplies,
W87-09213 5B

Groundwater Transport: Handbook of Mathematical Models,
W87-09306 5B

Septic Tank System Effects on Ground Water Quality,
W87-09310 5C

Metal Precipitation in Two Landfill Leachates,
W87-09368 5G

Maintenance and Stability of Introduced Genotypes in Groundwater Aquifer Material,
W87-09391 5B

Influence of Meltwater on the Amount and Composition of Groundwater in Quaternary Deposits in Finland,
W87-09460 2F

Contamination of Groundwater by Hydrocarbons from a Refinery - A Case History,
W87-09547 5G

Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I and II.
W87-09568 2F

Influence on the Groundwater Conditions in a Multilayered Aquifer System by Alum-Shale Mining,
W87-09570 5C

GROUNDWATER POTENTIAL
Groundwater Resource Development,
W87-09148 6D

GROUNDWATER QUALITY
Photolytic Ozonation for Protection and Rehabilitation of Ground-Water Resources; A Mechanistic Study,
W87-09092 5G

Ground Water Pollution Control,
W87-09150 5G

Septic Tank System Effects on Ground Water Quality,
W87-09310 5C

GROUNDWATER RECHARGE
Estimation of Groundwater Recharge in Sandy Till with Two Different Methods Using Groundwater Level Fluctuations,
W87-08615 2F

Groundwater Recharge and Discharge Response to Rainfall on a Hillslope,
W87-08706 2F

Hydraulic/Chemical Changes During Ground-Water Recharge by Injection,
W87-08751 5B

Artificial Ground Water Recharge by Flooding During Grapevine Dormancy,
W87-08979 2F

Congressional Initiatives,
W87-09133 5G

Origin and Dynamics of the Waters Flowing into the Mining Works in Reocin (Santander, Spain) (Sobre el Origen y Dinamica de las Aguas Fluyentes a las Explotaciones Mineras de Reocin (Santander, Espana)),
W87-09586 2F

GROUTING
Detection of Defects in a Grout Curtain by Geophysical Methods,
W87-09358 8E

High Pressure Grouting in Deep Gold Mines,
W87-09592 4B

Application of New Chemical Grouts in Strengthening and Sealing of Soils,
W87-09594 8G

GROWTH
Measuring Fish Lengths from Instant Photographs Using a Digitizing Tablet and Minicomputer,
W87-08649 7B

Effects of Distillery Waste on the Performance of Cicer arietinum L.,
W87-08873 5C

Growth of Mixed Microbial Populations in Ground Water Containing Highly Chlorinated Organic Wastes,
W87-08878 5B

Spring Wheat Growth at High and Low Soil Water with Constricted Upper Roots,
W87-08893 2D

Biocidal Control of Legionellae,
W87-08904 5F

GROWTH RATES
Effects of Flooding, Tilting of Stems, and Ethrel Application on Growth, Stem Anatomy and Ethylene Production of Pinus Densiflora Seedlings,
W87-08797 2I

GROWTH STAGES
Toxicity of Picloram (4-Amino-3,5,6-Trichloropicolinic Acid) to Life Stages of the Rainbow Trout,
W87-08877 5C

GULLY EROSION
Gulley Control,
W87-08669 3F

GYPSUM BEDS
Improvement of Irrigation Water by Gypsum Beds,
W87-08745 5G

HABITAT MODIFICATION
Effect of Habitat Modification on Freshwater Fisheries in Lowland Areas of Eastern England,
W87-09050 2H

Effects of Habitat Modification on Freshwater Crayfish,
W87-09062 4C

HABITATS
Examination of Tidal Flats, Vol. 1: Research Report.
W87-09492 4C

Swimming Performance of Fishes Endemic to the Missouri River in South Dakota,
W87-09496 8I

HALOGENATED PESTICIDES
Organochlorine Pesticide Residues in Fish from the Shatt al-Arab River, Iraq,
W87-08880 5B

Residues of Organochlorine Pesticides in Environmental Samples from the Shatt-al-Arab River, Iraq,
W87-08910 5B

HALOPHYTES
Induction of Crassulacean Acid Metabolism in Mesembryanthemum crystallinum by High Salinity: Mass Increase and de Novo Synthesis of PEP-Carboxylase,
W87-09418 3C

HANDBOOKS
Erosion and Sediment Control Handbook,
W87-08686 4D

Handbook of Public Water Systems.
W87-09063 5F

Handbook of Chlorination,
W87-09064 5D

Handbook of Ozone Technology and Applications Volume II: Ozone for Drinking Water Treatment.
W87-09134 5F

HARDNESS
Geochemistry, Soils and Cardiovascular Diseases,
W87-08692 2F

HARMONIZATION
Harmonization of Biological Testing Methodology: A Performance-Based Approach,
W87-08646 5A

HARRY ALLEN GENERATING STATIONS
Study of Saline Water Use at the Harry Allen Generating Station,
W87-09332 3C

HAWAII
Coast Guard Environmental Mission Fulfilled by Naval Salvage, French Frigate Shoals,
W87-09530 5G

HAZARD ASSESSMENT
Field Confirmation of a Laboratory-Derived Hazard Assessment of the Acute Toxicity of Fenthion to Pink Shrimp, Penaeus duorarum,
W87-08638 5C

Aquatic Hazard Assessment: Picloram,
W87-08643 5C

Use of Asiatic Clam Larvae in Aquatic Hazard Evaluations,
W87-09326 5C

HAZARD ASSESSMENTS
Aquatic Toxicology and Hazard Assessment: Eighth Symposium.
W87-08624 6E

HEAVY METALS
Acclimation as a Factor Influencing Metal Criteria,
W87-08635 5C

Geochemical Partitioning of Heavy Metals in Sediments of Three Estuaries Along the Coast of Rio de Janeiro (Brazil),
W87-08717 2L

Heavy Metal Pollution in the Paraiba do Sul River, Brazil,
W87-08718 5B

Quantities of Cadmium, Lead, Mercury and Arsenic Entering the U.K. Environment from Human Activities,
W87-08728 5B

Composition of Suspended Particulate Matter from Scottish Coastal Waters Geochemical Implications for the Transport of Trace Metal Contaminants,
W87-08729 5B

Seasonal Variation of Copper and Zinc Concentrations in the Oyster Saccostrea cuccullata from the Dampier Archipelago, Western Australia: Implications for Pollution Monitoring,
W87-08732 5B

Heavy Metals in Lake Kinneret (Israel): II. Hydrogen Sulfide Dependent Precipitation of Copper, Cadmium, Lead and Zinc,
W87-08761 2H

Heavy Metal Pollution of the Mid-Canal of Kandy: An Environmental Case Study from Sri Lanka,
W87-08840 5C

Lead Nitrate Induced Changes in the Thyroid Physiology of the Catfish Clarias batrachus (L),
W87-08850 5C

Vertical Transport of Heavy Metals by Settling Particles in Lake Zurich,
W87-08869 5B

Use of the Pocketbook Mussel, Lampsilis ventricosa, for Monitoring Heavy Metal Pollution in an Ozark Stream,
W87-08875 5A

Metal-Binding Protein in the Pacific Oyster, Crassostrea gigas: Assessment of the Protein as a Biochemical Environmental Indicator,
W87-08885 5A

Correlation between Heavy Metal Acute Toxicity Values in Daphnia magna and Fish,
W87-08887 5A

Complete HF Digestion Method for Element and Trace Element Determination in Soils, Sediments, Sludges and Other Similar Samples Using a Closed System (HF-Totalaufschluss im geschlossenen System fur Element- und Spurenelementbestimmungen in Boden, Klarschlamm, Sedimenten u. a. Proben),
W87-08894 5A

Effect of Storage on the Distribution of Trace Elements (Lead, Cadmium, Copper, Zinc and Mercury) in Natural Water,
W87-08914 5A

Residues of Organochlorine Chemicals and Concentrations of Heavy Metals in Ciconiforme Eggs in Relation to Diet and Habitat,
W87-08916 5B

Residual Effects of Sewage Sludge on Soybean: I. Accumulation of Heavy Metals,
W87-08921 5C

Residual Effects of Sewage Sludge on Soybean: II. Accumulation of Soil and Symbiotically Fixed Nitrogen,
W87-08922 5C

Organic Matter and Heavy Metal Concentrations in the Particulate Phase of Lake Michigan Surface Microlayers,
W87-09171 5B

Rates of Accumulation of Heavy Metals in Pre- and Post-European Sediments in New England Lakes,
W87-09184 5B

Heavy Metals Distribution in the Sediments of Ganges and Brahmaputra Rivers,
W87-09204 5B

Effects of Cd(2+) and EDTA on Young Sugar Beets (Beta vulgaris). II. Net Uptake and Distribution of Mg(2+), Ca(2+), and Fe(2+)/Fe(3+),
W87-09228 2I

Bioaccumulation Potential of Heterotrophic Bacteria for Lead, Selenium, and Arsenic,
W87-09240 5B

Influence of Light on Chlorophyll, a Content of Blue-Green Algae Treated with Heavy Metals,
W87-09242 5C

Zinc, Iron, Manganese, and Magnesium Accumulation in Crayfish Populations Near Copper - Nickel Smelters at Sudbury, Ontario, Canada,
W87-09243 5C

Zinc, Copper and Nickel Concentrations in Soil Extracts and Crops Grown on Four Soils Treated with Metal-loaded Sewage Sludges,
W87-09244 5B

Hydrological and Chemical Factors Controlling the Concentrations of Fe, Cu, Zn and As in a River System Contaminated by Acid Mine Drainage,
W87-09277 5B

Metal Precipitation in Two Landfill Leachates,
W87-09368 5G

Heavy Metal Concentrations in the Liver of Three Duck Species: Influence of Species and Sex,
W87-09380 5B

HEAVY WATER
Trees as Indicators of Subterranean Water Flow from a Retired Radioactive Waste Disposal Site,
W87-08845 5A

HENRY'S LAW
Air-Water Phase Equilibria of Volatile Organic Solutes,
W87-08956 5F

HEPATITUS A
A-ELISA to Detect Hepatitis A Virus in Estuarine Samples,
W87-09396 5A

HERBICIDES
Toxicity of Picloram (4-Amino-3,5,6-Trichloropicolinic Acid) to Life Stages of the Rainbow Trout,
W87-08877 5C

HERBIVORY
Impact of Irrigation and Experimental Drought Stress on Leaf-Mining Insects of Emory Oak,
W87-09402 2I

HETEROGENEOUS SOILS
Modelling of Unsaturated Flow in Heterogeneous Soils Part I: Deterministic Simulations of Water Flow in Soil Profiles,
W87-08816 2G

HETEROTROPHIC BACTERIA
Bioaccumulation Potential of Heterotrophic Bacteria for Lead, Selenium, and Arsenic,
W87-09240 5B

HIGHWAY EFFECTS
Examination of Tidal Flats, Vol. 1: Research Report.
W87-09492 4C

Examination of Tidal Flats, Vol. 3: Evaluation Methodology.
W87-09493 4C

HISTOLOGY
Effect of Ingested Benzo(a)pyrene and Cadmium on Tissue Accumulation, Hydroxylase Activity, and Intestinal Morphology of the Black Sea Bass, Centropristis striata,
W87-08842 5C

In Vitro Cytotoxicity of Organic Pollutants to Bluegill Sunfish (BF-2) Cells,
W87-08843 5C

HISTOPATHOLOGY
Histopathology,
W87-09290 5C

HISTORY
History of the Carlsbad Basin, Southeastern New Mexico,
W87-09151 6G

Pecos Past: The Prehistory and History of the Brantley Project Locality,
W87-09155 6G

Prehistoric Hunter-Gatherers of South Central Arizona: The Picacho Reservoir Archaic Project,
W87-09191 6G

HOHOKAM
Yakima River Basin Historical Resource Survey, Volume I: Overview and Management Recommendations,
W87-09192 6G

HOLOTHUROIDEA
Chlorinated Insecticides and PCBs in Asteroidea and Holothuroidea Species from Rijeka Bay, Yugoslavia,
W87-08724 5B

HOSPITALS
Exposure to Legionella in Geriatric Institutions,
W87-08907 5B

HOT SPRINGS
Hydrogen Sulfide Poisonings in Hot-Spring Reservoir Cleaning: Two Case Reports,
W87-08614 5C

HUMAN DISEASES
Epidemiological Evidence of Legionellosis Transmission through Domestic Hot Water Supply Systems and Possibilities of Control,
W87-08905 5F

HUMIC ACIDS
Geochemistry of Stream Fulvic and Humic Substances,
W87-09073 2H

Geochemistry of Humin,
W87-09077 2H

Nature of Nitrogen in Humic Substances,
W87-09078 2H

Fractionation of Soil Humic Substances,
W87-09081 2G

Molecular Size and Weight Measurements of Humic Substances,
W87-09085 7B

Acidic Functional Groups of Humic Substances,
W87-09086 2K

Spectroscopic Methods (Other Than NMR) for Determining Functionality in Humic Substances,
W87-09087 7B

Application of Nuclear Magnetic Resonance Spectroscopy for Determining Functionality in Humic Substances,
W87-09088 7B

HUMIC LAKES
Three Day Study of the Diel Behaviour of Plankton in a Highly Humic and Steeply Stratified Lake,
W87-08766 2H

HUMIC SUBSTANCES
Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization.
W87-09067 2H

Geochemistry of Soil Humic Substances,
W87-09068 2J

Geochemistry of Humic Substances in Natural and Cultivated Peatlands,
W87-09069 2H

Humic Substances in Groundwater,
W87-09070 2F

Geochemistry and Ecological Role of Humic Substances in Lakewater,
W87-09071 2H

Geochemistry of Humic Substances in Lake Sediments,
W87-09072 2H

Geochemistry of Humic Substances in Estuarine Environments,
W87-09074 2H

Geochemistry of Humic Substances in Seawater,
W87-09075 2L

Geochemistry of Humic Substances in Marine Sediments,
W87-09076 2J

Geochemistry of Humin,
W87-09077 2H

Extraction of Humic Substances from Soil,
W87-09079 7B

Isolation and Concentration Techniques for Aquatic Humic Substances,
W87-09080 2H

Fractionation Techniques for Aquatic Humic Substances,
W87-09082 7B

Analytical Methodology for Elemental Analysis of Humic Substances,
W87-09083 7B

Implications of Elemental Characteristics of Humic Substances,
W87-09084 7B

Molecular Size and Weight Measurements of Humic Substances,
W87-09085 7B

Acidic Functional Groups of Humic Substances,
W87-09086 2K

Spectroscopic Methods (Other Than NMR) for Determining Functionality in Humic Substances,
W87-09087 7B

Application of Nuclear Magnetic Resonance Spectroscopy for Determining Functionality in Humic Substances,
W87-09088 7B

HUMIDITY
Relationship of Low-Level Winds and Moisture to Convection in the Tropical Pacific,
W87-08941 2B

Responses of Gas Exchange to Humidity in Populations of Three Herbs from Environments Differing in Atmospheric Water,
W87-09346 2I

HUMIFICATION
Geochemistry of Humic Substances in Natural and Cultivated Peatlands,
W87-09069 2H

HUMIN
Geochemistry of Humin,
W87-09077 2H

Nature of Nitrogen in Humic Substances,
W87-09078 2H

HYDRATED SALTS
Recovery of Water from Atmospheric Air in Arid Climates,
W87-08601 5F

HYDRATION
Physiological Responses to Drought of Lolium perenne L.: Measurement of, and Genetic Variation in, Water Potential, Solute Potential, Elasticity and Cell Hydration,
W87-08848 2D

HYDRAULIC CONDUCTIVITY
Determination of Hydraulic Conductivity from Auger Holes and Pits - An Approximation,
W87-08617 2F

Variation of the Subsoil Hydraulic Conductivities of Some New Zealand Soils with Changes in Water Tension,
W87-08736 2G

Effect of Exchangeable Sodium Percent on Surface Sealing,
W87-08742 4D

Hydraulic/Chemical Changes During Ground-Water Recharge by Injection,
W87-08751 5B

Field Method for Estimating Hydraulic Conductivity and Matric Potential-Water Content Relations,
W87-08993 2G

Reduction in Hydraulic Conductivity in Relation to Clay Dispersion and Disaggregation,
W87-08996 2G

Evaluating Asphalt Cap Effectiveness at Superfund Site,
W87-09379 5E

HYDRAULIC DESIGN
Design of Spillway Crests,
W87-09195 8A

Fish Diversion in Hydropower Intake,
W87-09197 8I

Streambank Protection by Submerged Vanes,
W87-09198 4D

HYDRAULIC DESIGNS
Hydraulic Model Study of Port Huron Ice Control Structure,
W87-09473 2C

HYDRAULIC ENGINEERING
Lateral Outflow over Side Weirs,
W87-09196 8A

Fish Diversion in Hydropower Intake,
W87-09197 8I

BASIC Hydraulics,
W87-09304 8B

Design and Use of Pressure Sewer Systems,
W87-09309 5D

Influence of Underground Engineering Works on Hydrogeological Conditions of the Suburban Areas,
W87-09581 2F

HYDRAULIC EQUIPMENT
Fixed-Cone Valve Prototype Tests, Final Series, New Melones Dam, California,
W87-09483 8C

Pumping Performance and Turbidity Generation of Model 600/100 Pneuma Pump: Main Text and Appendixes A and B,
W87-09487 8C

HYDRAULIC MACHINERY
Status of DOE Small Hydropower Research and Development Projects.
W87-09478 8C

Fixed-Cone Valve Prototype Tests, Final Series, New Melones Dam, California,
W87-09483 8C

Pumping Performance and Turbidity Generation of Model 600/100 Pneuma Pump: Main Text and Appendixes A and B,
W87-09487 8C

HYDRAULIC MODELS
Determining Optimum Pumping Rates for Creation of Hydraulic Barriers to Ground-Water Pollutant Migration,
W87-09108 5G

Hydraulic Model Study of Port Huron Ice Control Structure,
W87-09473 2C

Low Freshwater Inflow Study: Chesapeake Bay Hydraulic Model Investigation,
W87-09484 2L

Kahului Breakwater Stability Study, Kahului, Maui, Hawaii: Hydraulic Model Investigation,
W87-09488 8B

HYDRAULIC PROPERTIES
Open-Channel Hydraulics,
W87-08688 8B

HYDRAULIC STRUCTURES
Geotechnical Aspects of Corani Reservoir Enlargement,
W87-08794 8A

Predicting Settlement at a Damsite on a Tunnel Valley Deposit in Alberta,
W87-08795 8A

Groundwater Modelling for Hydropower Development in Iceland,
W87-08829 2F

Post-Pool Raise Spillway Prototype Test for Chief Joseph Dam Columbia River, Washington,
W87-09153 8A

Design of Spillway Crests,
W87-09195 8A

Fish Diversion in Hydropower Intake,
W87-09197 8I

Streambank Protection by Submerged Vanes,
W87-09198 4D

Overtopping Risk for an Existing Dam,
W87-09461 8A

Detailed Project Report and Environmental Assessment: Section 111, Shores East of Diked Disposal Area, Lorain Harbor, Ohio.
W87-09491 6G

HYDRAULIC VALVES

Fixed-Cone Valve Prototype Tests, Final Series, New Melones Dam, California,
W87-09483 8C

HYDRAULICS

Lateral Outflow over Side Weirs,
W87-09196 8A

Internal Hydraulics of Diffusers with Uniform Lateral Momentum Distribution,
W87-09366 8B

Erosion Control of Scour During Construction; Report 6: FINITE - A Numerical Model for Combined Refraction and Diffraction of Waves,
W87-09482 8B

HYDROBIIDAE

Dispersal-Mediated Coexistence of Mud Snails (Hydrobiidae) in an Estuary,
W87-09422 2L

HYDROCARBONS

Regulatory Identification of Petroleum Hydrocarbons in Dredged Material,
W87-09154 5A

Response of Marine Animals to Petroleum and Specific Petroleum Hydrocarbons,
W87-09308 5C

Simultaneous Determination of Linear Alkylbenzenesulfonates, Alkylphenol Polyethoxylates, and Nonylphenol by High-Performance Liquid Chromatography,
W87-09343 5A

Processes Affecting the Distribution of Low-Molecular-Weight Aliphatic Hydrocarbons in Cook Inlet, Alaska,
W87-09506 5B

Distribution of Aromatic Hydrocarbons in Port Valdez, Alaska,
W87-09513 5B

Toxicity of Ballast-Water Treatment Effluent to Marine Organisms at Port Valdez, Alaska,
W87-09514 5C

Effectiveness of Offshore Produced Water Treatment,
W87-09515 5D

HYDRODYNAMICS

River Flow with Excessive Suspended Sediment Load: An Evaluation of Turbulent Flow Characteristics,
W87-08826 2E

Lateral Mixing in Channels Due to Secondary Currents,
W87-08827 2E

Hydrodynamics and Structure: Interactive Effects on Meiofauna Dispersal,
W87-08838 2L

Internal Waves of the Second Vertical Mode in a Stratified Lake,
W87-08863 2H

Structure and Dynamics of Internal Waves in Baldeggersee,
W87-08864 2H

Dynamics of Bottom Currents in a Small Lake,
W87-08865 2H

Surface Manifestations of Internal Oscillations in a Highly Saline Lake (the Dead Sea),
W87-08866 2H

Lateral Outflow over Side Weirs,
W87-09196 8A

Programmed Closing of Gates Upon Loss of Drive by a Pump Unit,
W87-09355 8C

Internal Hydraulics of Diffusers with Uniform Lateral Momentum Distribution,
W87-09366 8B

Turbulence Statistics in Fully Developed Channel Flow at Low Reynolds Number,
W87-09383 8B

Conformal-Mapping Technique for Topographic-Wave Problems: Semi-Infinite Channels and Elongated Basins,
W87-09384 7C

Scanning Currents in Stokes Flow and the Efficient Feeding of Small Organisms,
W87-09385 2H

Developments in LARM2: A Longitudinal-Vertical, Time-Varying Hydrodynamic Reservoir Model,
W87-09489 8B

HYDROELECTRIC PLANTS

Fish Diversion in Hydropower Intake,
W87-09197 8I

HYDROELECTRIC POWER

Groundwater Modelling for Hydropower Development in Iceland,
W87-08829 2F

Repurcussion of Small Hydroelectric Power Stations on Populations of Brown Trout (Salmo trutta) in Rivers in the French Massif-Central,
W87-09041 6G

Small-Scale Hydroelectric Power.
W87-09110 6A

Future Trends in Hydropower Development in China,
W87-09407 8A

Status of DOE Small Hydropower Research and Development Projects.
W87-09478 8C

HYDROELECTRIC POWER STATIONS

Arch Dam of the Khudoni Hydroelectric Station,
W87-09353 8A

HYDROELECTRIC STATIONS

Seepage Regime in the Foundation of the Kanev Hydroelectric Station,
W87-09364 8D

HYDROFLUORIC ACID

Complete HF Digestion Method for Element and Trace Element Determination in Soils, Sediments, Sludges and Other Similar Samples Using a Closed System (HF-Totalaufschluss im geschlossenen System fur Element- und Spurenelementbestimmungen in Boden, Klarschlamm, Sedimenten u. a. Proben),
W87-08894 5A

HYDROGEN ION CONCENTRATION

Effects of pH and Soil Type on Concentrations of Zinc, Copper and Nickel Extracted by Calcium Chloride from Sewage Sludge-Treated Soils,
W87-08911 5B

Rainfall Acidity as Related to Meteorological Parameters in Northern Quebec,
W87-08943 2B

Theory and Practice in the Electrometric Determination of pH in Precipitation,
W87-08949 7B

HYDROGEN SULFIDE

Hydrogen Sulfide Poisonings in Hot-Spring Reservoir Cleaning: Two Case Reports,
W87-08614 5C

Ammonia, Hydrogen Sulphide and Methyl Mercaptides in Finnish Municipal Sewage Plants and Pumping Stations,
W87-08725 5D

Heavy Metals in Lake Kinneret (Israel): II. Hydrogen Sulfide Dependent Precipitation of Copper, Cadmium, Lead and Zinc,
W87-08761 2H

HYDROLOGIC CYCLE

Simulation of the Hydrologic Cycle for Watersheds,
W87-09111 2A

HYDROLOGIC DATA

Hydrological Maps: Development of a System for Calculation and Presentation,
W87-08812 7C

HYDROLOGIC DATA COLLECTIONS

Urban Stormwater Hydrology.
W87-09096 4C

Data Collection and Instrumentation,
W87-09103 7B

Basic Data Report for Drilling and Hydrologic Testing of Drillhole DOE-2 at the Waste Isolation Pilot Plant (WIPP) Site,
W87-09333 5E

Stream Water Quality in the Coal Region of Virginia,
W87-09494 4C

Hydrogeological Problems Affecting the Exploitation of the Peat Bog at Padul (Granad, Spain). Preliminary Study (Problemas Hidrogeologicos que Afectan a la Explotacion de la Turbera de Padul (Granad, Espana). Estudio Preliminar),
W87-09576 4A

HYDROLOGIC MAPS

Hydrological Maps: Development of a System for Calculation and Presentation,
W87-08812 7C

HYDROLOGIC MODELS

WATBAL: A Semi-Distributed, Physically Based Hydrological Modelling System,
W87-08823 2G

Introduction to Urban Hydrology and Stormwater Managment,
W87-09097 4C

Rainfall for Urban Stormwater Design,
W87-09098 2B

Desk-Top Methods for Urban Stormwater Calculation,
W87-09100 2A

Overview of Urban Stormwater Models,
W87-09104 4C

Example Model Applications,
W87-09105 4C

Simulation of the Hydrologic Cycle for Watersheds,
W87-09111 2A

Influence of Structure on Underground Water Prediction and Occurrence at Rokana Mine, Kitwe, Zambia,
W87-09572 2F

Proposed Hydrogeological Model for Future Lignite Mining and Groundwater Drainage in the Hula Basin, Northern Israel,
W87-09578 2F

Origin and Dynamics of the Waters Flowing into the Mining Works in Reocin (Santander, Spain) (Sobre el Origen y Dinamica de las Aguas Fluyentes a las Explotaciones Mineras de Reocin (Santander, Espana)),
W87-09586 2F

HYDROLOGIC PROPERTIES
Basic Data Report for Drilling and Hydrologic Testing of Drillhole DOE-2 at the Waste Isolation Pilot Plant (WIPP) Site,
W87-09333 5E

HYDROLOGIC STUDIES
Hydrology,
W87-08662 2A

HYDROLOGY
Hydrology and Drainage of Peatland,
W87-09201 2G

Economic, Legal, and Hydrologic Dimensions of Potential Interstate Water Markets,
W87-09211 6C

Subglacial Drainage for an Ice Sheet Resting Upon a Layered Deformable Bed,
W87-09248 2F

HYDROLYSIS
Determination of Monomeric and Polynuclear Aluminum(III) Species and Hydrolysis Constants,
W87-08611 1B

Hydrolysis,
W87-08681 5B

HYDROPHOBIC-GRID MEMBRANE FILTER
Comparison of the Hydrophobic-Grid Membrane Filter Procedure and Standard Methods for Coliform Analysis of Water,
W87-09392 5A

HYDROPOWER DEVELOPMENT
Future Trends in Hydropower Development in China,
W87-09407 8A

Sri Lanka's Randenigala Project,
W87-09412 8A

HYDROTHERMAL STUDIES
Internal Waves of the Second Vertical Mode in a Stratified Lake,
W87-08863 2H

HYDROXYLASES
Embryotoxicity, Teratogenicity, and Aryl Hydrocarbon Hydroxylase Activity in Forster's Terns on Green Bay, Lake Michigan,
W87-08841 5C

HYPEREUTROPHIC LAKES
Thymidine Incorporation and Microbial Respiration in the Surface Sediment of a Hypereutrophic Lake,
W87-08936 2H

HYPOCHLORITES
Kinetics and Mechanisms of Hypochlorite Oxidation of alpha-Amino Acids at the Time of Water Disinfection (Cinetiques et Mechanismes de l'Action Oxydative de l'Hypochlorite sur les Acides alpha-Amines lors de la Desinfection des Eaux),
W87-09274 5F

HYPOLIMNION
Investigation and Discussion of Techniques for Hypolimnion Aeration/Oxygenation,
W87-09481 5G

ICE COVER
Winter Flow, Ice, and Weather Conditions of the Upper St. Lawrence River, 1971-81; Volume I: Ice Cover Charts (Part A),
W87-09475 2E

ICE CRYSTALS
Numerical Simulation of the Effects of Varying Ice Crystal Nucleation Rates and Aggregation Processes on Orographic Snowfall,
W87-08697 2B

ICE LOAD
Determination of the Ice Load on Elements of Marine Hydraulic Structures,
W87-09359 8A

ICE PRESSURED
Conditions for Crack Propagation by Frost Wedging,
W87-09350 2C

ICE SHEETS
Subglacial Drainage for an Ice Sheet Resting Upon a Layered Deformable Bed,
W87-09248 2F

In Situ Cosmogenic 3H, 14C, and 10Be for Determining the Net Accumulation and Ablation Rates of Ice Sheets,
W87-09249 2C

ICED LAKES
Photosynthate Distribution by Microplankton in Permanently Ice-Covered Antarctic Desert Lakes,
W87-08872 2H

IGNITERS
Oil Slick Igniter for remote Areas,
W87-09559 5G

ILLINOIS
Hydrogeology of Underground Coal Mines in Illinois,
W87-09573 2F

ILLINOIS RIVER
Meredosia Oil Terminal - The Illinois River Floods a Tank Farm,
W87-09531 5G

IMMISCIBLE FLUIDS
Modeling the Flow of Immiscible Fluids in Soils,
W87-09258 2G

IMMOBILIZATION TECHNOLOGY
Methane Recovery from Water Hyacinth Through Whole-Cell Immobilization Technology,
W87-09420 5D

IMMUNOLOGY
Immunological Dietary Analysis of Two Penaeid Shrimp Species from a South Carolina Tidal Creek,
W87-08988 2L

IMPAIRED WATER USE
Irrigation with Brackish Water under Desert Conditions: IV. Salt Tolerance Studies with Lettuce (Lactuca sativa L.),
W87-08746 3C

Irrigation with Brackish Water under Desert Conditions: V. Nitrogen Requirement of Tomatoes (Lycopersicon esculentum Mill.) during Germination under Drip Irrigation,
W87-08747 3C

Effects of Distillery Waste on the Performance of Cicer arietinum L.,
W87-08873 5C

Soil Clogging During Subsurface Wastewater Infiltration as Affected by Effluent Composition and Loading Rate,
W87-08928 5C

Perennial Pasture Production after Irrigation with Saline Groundwater in the Goulburn Valley, Victoria,
W87-09208 3C

Induction of Crassulacean Acid Metabolism in Mesembryanthemum crystallinum by High Salinity: Mass Increase and de Novo Synthesis of PEP-Carboxylase,
W87-09418 3C

IMPELLERS
Perspectives on the Scale-Up of Impeller Mixers,
W87-09434 5D

INCINERATION
Oil Slick Igniter for remote Areas,
W87-09559 5G

Development of a Flaring Burner Oil Disposal System,
W87-09560 5D

INCINERATOR ASH
Attenuation of Cd and Pb Solubility in Municipal Waste Incinerator Ash,
W87-08776 5E

INDIA
Water Use of Eucalypts - A Review with Special Reference to South India,
W87-08749 6G

Shifting of the Kosi River, Northern India,
W87-08834 2E

Empirical Prediction of the Summer Monsoon Rainfall over India,
W87-08940 2B

Small-Scale Surface (Tank) Irrigation in Asia,
W87-09015 3F

Irrigation in India: A Physiological and Phenological Approach to Water Management in Grain Crops,
W87-09468 3F

Role of Hydrogeology in Coal Mining Near Chandrapur in Maharashtra, India,
W87-09569 2F

INDIAN OCEAN
Water Vapor Transport Over the Indian Ocean During the 1979 Summer Monsoon. Part I: Water Vapor Fluxes,
W87-08937 2B

INDIANA
Ecological Factors in the Selection of Representative Species for Thermal Effluent Demonstrations,
W87-09315 5C

INDUS RIVER
Nature of Organic Matter in Rivers with Deep Sea Connections: The Ganges-Brahmaputra and Indus,
W87-08721 2H

INDUSTRIAL WASTES
What Industry is Doing to Protect Aquatic Life,
W87-08628 5G

Management of Industrial Pollutants by Anaerobic Processes,
W87-09190 5D

Leaching Behaviors of Low-Sulfur Coals and Coal Wastes from Three Western Coal Preparation Plants,
W87-09429 5B

INDUSTRIAL WASTEWATER
Studies on Water Hyacinth as a Biological Filtre for Treating Contaminants from Agricultural Wastes and Industrial Effluents,
W87-08609 5D

Acute and Chronic Toxicity to the Fathead Minnow, Pimephales promelas, of Effluents from a Treatment Plant Receiving Dye and Pigment Processing Wastewater,
W87-08656 5C

Impact-Sensitiveness of Soil Oribatid Species to the Waste Water from a Coal Distillation Plant,
W87-08898 5A

Biological Denitrification of a Highly Nitrogenous Industrial Effluent: A Case Study in Zimbabwe,
W87-08964 5D

Scale-Up and Scale-Down Concepts and Problems,
W87-09432 5D

Scale-Up of a Radium-226 Removal Process,
W87-09448 5D

Role of Kinetic Models for the Scale-Up of Biological Processes,
W87-09450 5D

Scale-Up of Activated Sludge and Trickling Filter Processes,
W87-09451 5D

Scale-Up Experience with the Waterloo SCP Process in Industrial Biomass Waste Treatment,
W87-09455 5D

INFAUNAL COMMUNITIES
Fate of the Zoe Colocotroni Oil Spill and its Effects on Infaunal Communities Associated with Mangroves,
W87-09544 5C

INFILTRATION
Laboratory Experiment on the Role of Grass for Infiltration and Runoff Processes,
W87-08622 2A

Groundwater Recharge and Discharge Response to Rainfall on a Hillslope,
W87-08706 2F

Soil Water Balance Model for Sloping Land,
W87-08735 2A

Effect of Exchangeable Sodium Percent on Surface Sealing,
W87-08742 4D

Surge Irrigation Management,
W87-08744 3F

Soil Clogging During Subsurface Wastewater Infiltration as Affected by Effluent Composition and Loading Rate,
W87-08928 5C

Steady-State Analysis of Infiltration and Overland Flow for Spatially-Varied Hillslopes,
W87-08974 2E

Solute Transport During Absorption and Infiltration: A Comparison of Analytical Approximations,
W87-08990 7C

Quasi-Solution of Richards' Equation for the Downward Infiltration of Water into Soil,
W87-09019 2G

Gravity Drainage Analysis for Scale Heterogeneous Porous Materials Under Falling Water Table Conditions,
W87-09020 2G

Robust-Resistant Spatial Analysis of Soil Water Infiltration,
W87-09029 7C

Rainfall Abstractions,
W87-09099 2A

Physical Changes Induced by Rainfall in the Surface Layer of an Alfisol, Northern Nigeria,
W87-09214 2G

Wastewater-Induced Soil Clogging Development,
W87-09373 5C

INFLUENCE FUNCTION METHOD
Radar Rainfall Data Quality Control by the Influence Function Method,
W87-09022 7C

INFORMATION RETRIEVAL
Information Retrieval System: Impacts of Water-Level Changes on Uses of Federal Storage Reservoirs of the Columbia River; Appendix F: RIVOPR User's Manual,
W87-09477 10B

INFORMATION SYSTEMS
Hydrological Maps: Development of a System for Calculation and Presentation,
W87-08812 7C

INJECTION WELLS
Hydraulic/Chemical Changes During Ground-Water Recharge by Injection,
W87-08751 5B

INORGANIC COMPOUNDS
NBS Environmental Standard Reference Materials for Use in Validating Water Analysis,
W87-09127 5A

Adsorption of Inorganic Pollutants in Aquatic Systems,
W87-09194 5B

INSECTICIDES
Acute Toxicity of Emulsifiable Concentrations of Three Insecticides Commonly Found in Nonpoint Source Runoff into Estuarine Waters to the Mummichog, Fundulus heteroclitus,
W87-08881 5C

Effect of Irrigation on Persistent Toxicity of Insecticides Applied as Granules to Soil to Brown Plant Hopper and Rice Swarming Caterpillar,
W87-08897 5B

Effect of Mosquito Killer Insecticides on Freshwater Mussels,
W87-08908 5C

Fate of 14C-Lindane in a Rice-Fish Model Ecosystem,
W87-08915 5B

INSECTS
Effect of Irrigation on Persistent Toxicity of Insecticides Applied as Granules to Soil to Brown Plant Hopper and Rice Swarming Caterpillar,
W87-08897 5B

Impact of Irrigation and Experimental Drought Stress on Leaf-Mining Insects of Emory Oak,
W87-09402 2I

INSTITUTIONAL ANALYSIS
Institutional Analysis in Community Decision-Making: A Case Example from Southern Arizona,
W87-08981 6A

INSTRUMENTATION
Embankment Dam Instrumentation Manual,
W87-09157 8A

INTERCEPTION
Interception Losses of Rainfall from Cashew Trees,
W87-08621 2I

Rainfall Abstractions,
W87-09099 2A

INTERNAL WAVES
Internal Waves of the Second Vertical Mode in a Stratified Lake,
W87-08863 2H

Structure and Dynamics of Internal Waves in Baldeggersee,
W87-08864 2H

INTERNATIONAL AGREEMENTS
Scientific Considerations in the International Arena,
W87-08626 6E

INTERSTITIAL WATER
New Method for Determining the Concentrations of Volatile Organic Compounds in Sediment Interstitial Water,
W87-09233 5A

INTERTIDAL AREAS
Predation Risk and Use of Intertidal Habitats by Young Fishes and Shrimp,
W87-08787 2L

Fate and Effects of Dispersant-Treated Compared with Untreated Crude Oil, with Particular Reference to Sheltered Intertidal Sediments,
W87-09537 5G

Effects of the Ixtoc I Oil Spill on the Intertidal and Subtidal Infaunal Populations Along Lower Texas Coast Barrier Island Beaches,
W87-09556 5C

INVERTEBRATES
Sestonic Bacteria as a Food Source for Filtering Invertebrates in Two Southeastern Blackwater Rivers,
W87-08870 2H

Influence of Substrate Stability on the Composition of Stream Benthos: An Experimental Study,
W87-09403 2H

ION EXCHANGE
Isolation of Mutagenic Components by High-Performance Liquid Chromatography from XAD Extract of Water from the Nishitakase River, Kyoto City, Japan,
W87-08723 5A

Systematic Approach to Adsorption on XAD-2 Resin for the Concentration and Analysis of Trace Organics in Water Below the (mu)g/l Level,
W87-09011 5A

Modeling for Process Scale-Up of Adsorption and Ion Exchange Systems,
W87-09446 5D

IOWA
Curbing THMs in Small Water Systems,
W87-08954 5F

IRAQ
Organochlorine Pesticide Residues in Fish from the Shatt al-Arab River, Iraq,
W87-08880 5B

IRAQ

Residues of Organochlorine Pesticides in Environmental Samples from the Shatt-al-Arab River, Iraq,
W87-08910 5B

IRELAND

Role of the Fisheries Engineer in the Design and Execution of Arterial Drainage Schemes,
W87-09044 8I

Impact of Agriculture on Surface Water in Ireland: Part I. General,
W87-09199 5B

Impact of Agriculture on Surface Water in Ireland: Part II. Prospects for the Future,
W87-09200 4C

Agricultural Drainage Practices in Ireland,
W87-09202 4A

Hydrogeological Aspects of Agricultural Drainage in Ireland,
W87-09203 2E

IRON

New Approach for Regulating Iron in Water Quality Standards,
W87-08636 5G

Removal of Iron and Manganese by Ozone during Drinking Water Treatment in Dusseldorf,
W87-09136 5F

Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XIII. The Effect of Fe(2+) on Photosynthesis and Respiration of Salix caprea and S. cinerea ssp. oleifolia,
W87-09400 2I

IRON GATES DAM

Effects on Fisheries of Non-Biotic Modifications of the Environment in the East-Danube River Area,
W87-09038 6G

IRON SLAG

Suppression of Phosphate Liberation from Sediment by Using Iron Slag,
W87-09273 5G

IRRADIANCE

Theory of Fluorescent Irradiance Fields in Lakes and Seas,
W87-09193 5A

IRRIGABLE LAND

Proposals for Agricultural Development of Wadi Dhuleil Catchment, Jordan,
W87-08739 3F

IRRIGATION

Engineering Measures: Water Harvesting,
W87-08668 3F

Leaching Losses from Irrigated Pasture: Waiau Irrigation Scheme, North Canterbury,
W87-08737 5B

Estimating Water Table Contribution to the Water Supply of Maize,
W87-08740 3F

Bare Soil Evaporation Near a Surface Point-Source Emitter,
W87-08743 2D

Irrigation with Brackish Water under Desert Conditions: IV. Salt Tolerance Studies with Lettuce (Lactuca sativa L.),
W87-08746 3C

Irrigation with Brackish Water under Desert Conditions: V. Nitrogen Requirement of Tomatoes (Lycopersicon esculentum Mill.) during Germination under Drip Irrigation,
W87-08747 3C

Impact of Irrigation and Experimental Drought Stress on Leaf-Mining Insects of Emory Oak,
W87-09402 2I

Advances in Irrigation, Volume 3.
W87-09464 3F

Traveling Trickle Irrigation System,
W87-09465 3F

Irrigation Practice for Crop Culture in the Southeastern United States,
W87-09466 3F

Time-Domain Reflectometry (TDR) and Its Application to Irrigation Scheduling,
W87-09467 3F

IRRIGATION CANALS

New Method for Lining of Field Irrigation Channels,
W87-08750 3F

Biological Control of Aquatic Weeds: The Efficacy of Hybrid Grass Carp in Two Southern California Irrigation Canals,
W87-09480 4A

IRRIGATION DESIGN

Estimating Water Table Contribution to the Water Supply of Maize,
W87-08740 3F

Water Production Functions for Wheat under Different Environmental Conditions,
W87-08748 3F

IRRIGATION DITCHES

Irrigation Practice for Crop Culture in the Southeastern United States,
W87-09466 3F

IRRIGATION EFFECTS

Proposals for Agricultural Development of Wadi Dhuleil Catchment, Jordan,
W87-08739 3F

Effect of Irrigation on Persistent Toxicity of Insecticides Applied as Granules to Soil to Brown Plant Hopper and Rice Swarming Caterpillar,
W87-08897 5B

Irrigated Agriculture and Groundwater Quality--A Framework for Policy Development,
W87-09212 6A

IRRIGATION EFFICIENCY

Water Production Functions for Wheat under Different Environmental Conditions,
W87-08748 3F

Traveling Trickle Irrigation System,
W87-09465 3F

Irrigation Practice for Crop Culture in the Southeastern United States,
W87-09466 3F

Time-Domain Reflectometry (TDR) and Its Application to Irrigation Scheduling,
W87-09467 3F

Irrigation in India: A Physiological and Phenological Approach to Water Management in Grain Crops,
W87-09468 3F

Estimating Evapotranspiration,
W87-09469 2D

IRRIGATION ENGINEERING

Traveling Trickle Irrigation System,
W87-09465 3F

IRRIGATION MANAGEMENT

Surge Irrigation Management,
W87-08744 3F

Water Production Functions for Wheat under Different Environmental Conditions,
W87-08748 3F

IRRIGATION PRACTICES

Advances in Irrigation, Volume 3.
W87-09464 3F

Traveling Trickle Irrigation System,
W87-09465 3F

Irrigation Practice for Crop Culture in the Southeastern United States,
W87-09466 3F

Time-Domain Reflectometry (TDR) and Its Application to Irrigation Scheduling,
W87-09467 3F

Irrigation in India: A Physiological and Phenological Approach to Water Management in Grain Crops,
W87-09468 3F

IRRIGATION PROGRAMS

Advances in Irrigation, Volume 3.
W87-09464 3F

Time-Domain Reflectometry (TDR) and Its Application to Irrigation Scheduling,
W87-09467 3F

IRRIGATION REQUIREMENTS

Time-Domain Reflectometry (TDR) and Its Application to Irrigation Scheduling,
W87-09467 3F

IRRIGATION SYSTEMS

Allocation Model for Irrigation Water Cost: Case Study of the Nile Valley in Egypt,
W87-08968 6C

Small-Scale Surface (Tank) Irrigation in Asia,
W87-09015 3F

IRRIGATION WATER

Improvement of Irrigation Water by Gypsum Beds,
W87-08745 5G

Perennial Pasture Production after Irrigation with Saline Groundwater in the Goulburn Valley, Victoria,
W87-09208 3C

ISOLATION

Isolation of Mutagenic Components by High-Performance Liquid Chromatography from XAD Extract of Water from the Nishitakase River, Kyoto City, Japan,
W87-08723 5A

Seasonality of Legionella Isolates from Environmental Sources,
W87-08902 2H

ISOPODS

Acute Toxicity of Brestan and Fentin Acetate on Some Freshwater Organisms,
W87-08876 5C

ISOTOPE FRACTIONATION

Estimation of Canopy Reservoir Capacity and Oxygen-18 Fractionation in Throughfall in a Pine Forest,
W87-08814 2B

ISOTOPE STUDIES

Rapid Aquatic Toxicity Assay Using Incorporation of Tritiated-Thymidine into Sea Urchin, Arbacia punctulata, Embryo: Evaluation of Toxicant Exposure Procedures,
W87-08655 5C

Fate of 14C-Lindane in a Rice-Fish Model Ecosystem,
W87-08915 5B

Mobility of Sludge-Borne 3,3'-Dichlorobenzidine in Soil Columns,
W87-08925 5B

Simultaneous Measurement of Primary Production by Whole-Lake and Bottle Radiocarbon Additions,
W87-08931 2H

15N/14N Ratios of Nitrate and Ammonium in Rain at Pretoria, South Africa,
W87-08944 2B

In Situ Cosmogenic 3H, 14C, and 10Be for Determining the Net Accumulation and Ablation Rates of Ice Sheets,
W87-09249 2C

ISOTOPIC TRACERS
Modelling Water Exchange and Transit Times in Till Basins Using Oxygen-18,
W87-08821 2A

Application of Isotope Techniques and Well Loggind in Investigating Ground Water Influenced by Mining,
W87-09580 2F

Origin and Dynamics of the Waters Flowing into the Mining Works in Reocin (Santander, Spain) (Sobre el Origen y Dinamica de las Aguas Fluyentes a las Explotaciones Mineras de Reocin (Santander, Espana)),
W87-09586 2F

ISRAEL
Hydrology,
W87-08662 2A

Seasonal Distribution of Legionellae Isolated from Various Types of Water in Israel,
W87-08903 5A

JAPONICA
Changes at Panicle Emergence in the Water Relations of a Wetland and a Dryland Japonica Rice Cultivar Under Wetland Conditions,
W87-09415 2I

KALOCHOE
Effects of Water Stress on Gas Exchange and Water Relations of Succulent Epiphyte, Kalanchoe Uniflora,
W87-09347 2I

KARLSRUHE
Recent Developments in the Treatment of Drinking Water with Ozone,
W87-09146 5F

KARST
Exploitation and Control of Karst Water in Coal Measures,
W87-09575 2F

Protection of the Karstic Springs System in Golubinka Against Contamination by the Sea Water (la Protection du Systeme des Sources Karstiques de Golubinka Contre la Contamination par la Mer),
W87-09582 4B

Plans and Experiments to Deal with Large Amounts of Sediment in Hungarian Mines under Karstic Water Hazard,
W87-09590 4C

KARST HYDROLOGY
Exploitation and Control of Karst Water in Coal Measures,
W87-09575 2F

System of Underground Water in a Karstic Country and the Tunnels Excavated for Water Transport to Athens (le Regime des Eaux Souterraines dans un Pays Karstique et les Galeries de la Grande Adduction d'Eau d'Athenes),
W87-09595 2F

Water Control Strategy of Mines Under Strong Karstic Water Hazard,
W87-09600 4B

KENTUCKY
Tracer Study of Vertical Exchange by Cumulus Clouds,
W87-08699 2A

KEOWEE RESERVOIR
Thermal and Dissolved Oxygen Characteristics of a South Carolina Cooling Reservoir,
W87-08975 2H

KHUDONI STATION
Arch Dam of the Khudoni Hydroelectric Station,
W87-09353 8A

KILLIFISH
Comparative Metabolism of Fenitrothion in Aquatic Organisms: I. Metabolism in the Euryhaline Fish, Oryzias latipes and Mugil cephalus,
W87-08859 5B

KINETIC ENERGY
Rainfall Kinetic Energy in Eastern Australia,
W87-08698 2B

KINETIC MODELS
Kinetic Models for Predicting Bioaccumulation of Pollutants in Ecosystems,
W87-09247 5B

KINETICS
Comparative Kinetics for Bioaccumulation of Polychlorinated Biphenyls by the Polychaete (Capitella capitata) and Fish (Mugil cephalus),
W87-08856 5B

Kinetics of Sulfate Adsorption and Desorption by Cecil Soil Using Miscible Displacement,
W87-08995 2G

Study of the Kinetics of the Adsorption by Activated Carbons of 2,4,5-Trichlorophenoxyacetic Acid from Aqueous Solution,
W87-09251 5D

Role of Kinetic Models for the Scale-Up of Biological Processes,
W87-09450 5D

Scale-Up of Activated Sludge and Trickling Filter Processes,
W87-09451 5D

KINZUA DAM
Use of Silica-Fume Concrete to Repair a Stilling Basin,
W87-09413 8F

KLEBSIELLA
Occurrence, Significance, and Detection of Klebsiella in Water Systems,
W87-08958 5A

KOSI RIVER
Shifting of the Kosi River, Northern India,
W87-08834 2E

KRAFT MILLS
Long-Term Effects of Bleached Kraft Mill Effluents on Carbohydrate Metabolism and Hepatic Xenobiotic Biotransformation Enzymes in Fish,
W87-08854 5C

LABORATORIES
Research Needs in Validating and Determining the Predictability of Laboratory Data to the Field,
W87-08631 5C

LACTUCA
Field Water Relations of a Compass Plant, Lactuca serriola L.,
W87-08772 2I

LAGOON EFFLUENTS
Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: I. Persistence, Yield, Quality, and Elemental Removal,
W87-08919 5C

Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: II. Rainfall Runoff and Soil Chemical Properties,
W87-08920 5C

LAGOONS
Swine Lagoon Effluent Applied to Coastal Bermudagrass,
W87-09472 5D

LAKE ALTUS
Report on Additional Human Skeletal Material Exposed by Reservoir Induced Erosion at Lake Altus, Southwestern Oklahoma,
W87-09161 6G

LAKE CHICKAMAUGA
Impact of Trinitrotoluene Wastewaters on Aquatic Biota in Lake Chickamauga, Tennessee,
W87-09322 5C

LAKE CISO
Ecology of a Cryptomonas phaseolus Population Forming a Metalimnetic Bloom in Lake Ciso, Spain: Annual Distribution and Loss Factors,
W87-08930 2H

LAKE GREIFEN
Carbon Isotope Fractionation and Changes in the Flux and Composition of Particulate Matter Resulting from Biological Activity during a Sediment Trap Experiment in Lake Greifen, Switzerland,
W87-08867 2H

LAKE HURON
Brood Size and Neonate Weight of Daphnia magna Produced by Nine Diets,
W87-08641 2H

Model for Estimating the Loading Rate of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin to the Great Lakes,
W87-08660 5B

Inputs of Polychlorinated Biphenyls from the Atmosphere to Lakes Huron and Michigan,
W87-09186 5B

LAKE INARI
Water Level Regulation of Lake Inari: Impacts and Compensation Measures,
W87-09053 2H

Development of Fish Stock and Fish Populations in Lake Inari,
W87-09054 2H

LAKE ISSAQUEENA
Seasonal Distribution of Thermotolerant Free-Living Amoebae. II. Lake Issaqueena,
W87-09225 2H

LAKE KAINJI
Distribution and Relative Abundance of the Nile Perch (Lates niloticus (L.) Pisces: Centropomidae) in Lake Kainji, Nigeria,
W87-08762 2H

LAKE KINNERET
Heavy Metals in Lake Kinneret (Israel): II. Hydrogen Sulfide Dependent Precipitation of Copper, Cadmium, Lead and Zinc,
W87-08761 2H

LAKE LEMAN
Contamination of Fish from the French Zone of Lake Leman by Organochlorine Compounds between 1973 and 1981 (Contamination des Poissons du Secteur Francais du Lac Leman, par les Composes Organochlores entre 1973 et 1981),
W87-08909 2H

LAKE LUGANO
Correlation of a Lake Eutrophication Model to Field Experiments,
W87-08900 2H

LAKE MICHIGAN
Counting the Days Along Lake Michigan,
W87-08804 2J

Embryotoxicity, Teratogenicity, and Aryl Hydrocarbon Hydroxylase Activity in Forster's Terns on Green Bay, Lake Michigan,
W87-08841 5C

Organic Matter and Heavy Metal Concentrations in the Particulate Phase of Lake Michigan Surface Microlayers,
W87-09171 5B

Transport and Dry Deposition of Trace Metals over Southern Lake Michigan,
W87-09179 5B

Atmospheric Concentrations and Deposition of Polychlorinated Biphenyls to Lake Superior,
W87-09185 5B

Inputs of Polychlorinated Biphenyls from the Atmosphere to Lakes Huron and Michigan,
W87-09186 5B

Atmospheric Deposition of Particulate Organic Carbon and Polyaromatic Hydrocarbons to Lake Michigan,
W87-09187 5B

LAKE MORPHOLOGY
Afforestation and Fisheries,
W87-09061 4C

LAKE NYOS
1986 Lake Nyos Gas Disaster in Cameroon, West Africa,
W87-08780 2H

LAKE OKEECHOBEE
Importance of Atmospheric Fluxes to the Nitrogen Balance of Lakes in the Florida Peninsula,
W87-09176 2H

Atmospheric Deposition of Acidity and Sulfur in Florida,
W87-09177 5B

LAKE ONALASKA
Sedimentation in Lake Onalaska, Navigation Pool 7, Upper Mississippi River, Since Impoundment,
W87-08969 2J

LAKE ONTARIO
Cadmium and Lead in Lake Ontario Salmonids,
W87-08883 2H

LAKE PYHAJARVI
Whitefish and Vendace Stocks in the Regulated Lake Pyhajarvi, Central Finland,
W87-09052 2H

LAKE SEDIMENTS
Regulation of Submerged Aquatic Plant Distribution in a Uniform Area of a Weedbed,
W87-08836 2H

Carbon Isotope Fractionation and Changes in the Flux and Composition of Particulate Matter Resulting from Biological Activity during a Sediment Trap Experiment in Lake Greifen, Switzerland,
W87-08867 2H

Geochemistry of Humic Substances in Lake Sediments,
W87-09072 2H

Rates of Accumulation of Heavy Metals in Pre- and Post-European Sediments in New England Lakes,
W87-09184 5B

Response of Lake Sediments to Changes in Trace Metal Emission from the Smelters at Sudbury, Ontario,
W87-09245 5B

Enhancement of Inorganic Nitrogen and Phosphate Release from Lake Sediment by Tubificid Worms and Chironomid Larvae,
W87-09404 2H

LAKE SHORES
Defending Our LakeShores,
W87-08674 4D

LAKE SUPERIOR
Atmospheric Concentrations and Deposition of Polychlorinated Biphenyls to Lake Superior,
W87-09185 5B

Ecological Factors in the Selection of Representative Species for Thermal Effluent Demonstrations,
W87-09315 5C

LAKE VECHTEN
Distribution of Particulate Matter in Relation to the Thermal Cycle in Lake Vechten (The Netherlands): The Significance of Transportation Along the Bottom,
W87-09275 2H

LAKE ZURICH
Vertical Transport of Heavy Metals by Settling Particles in Lake Zurich,
W87-08869 5B

LAKES
Modeling Chemical Transport in Lakes, Rivers, and Estuarine Systems,
W87-08672 5B

Defending Our LakeShores,
W87-08674 4D

Ecological Consequences of Artificial Changes in the Water Regime of Lakes and Their Significance for Forecasting,
W87-08708 6G

Transport of Arsenic and Mercury from Gold Mining Activities Through an Aquatic System,
W87-08731 5B

Distribution and Relative Abundance of the Nile Perch (Lates niloticus (L.) Pisces: Centropomidae) in Lake Kainji, Nigeria,
W87-08762 2H

Lake Effect on Stream Living Brown Trout (Salmo trutta),
W87-08763 2H

Three Day Study of the Diel Behaviour of Plankton in a Highly Humic and Steeply Stratified Lake,
W87-08766 2H

Bacteria as Structuring Agents in Lakes: Field Manipulations with Bacterioplankton,
W87-08768 2H

Qualitative Model of Eutrophication in Macrophyte Lakes,
W87-08785 2H

Catchment Effects on the Horizontal Distribution of Phytoplankton in Five of Scotland's Largest Freshwater Lochs,
W87-08790 2H

Comparison of Parasite Fauna of Juvenile Sockeye Salmon (Oncorhynchus Nerka) from Southern British Columbian and Washington State Lakes,
W87-08792 2H

Effects of Food Availability and Fish Predation on a Zooplankton Community,
W87-08799 2H

Counting the Days Along Lake Michigan,
W87-08804 2J

Internal Waves of the Second Vertical Mode in a Stratified Lake,
W87-08863 2H

Structure and Dynamics of Internal Waves in Baldeggersee,
W87-08864 2H

Dynamics of Bottom Currents in a Small Lake,
W87-08865 2H

Free Amino Acids in Lakes: Concentrations and Assimilation Rates in Relation to Phytoplankton and Bacterial Production,
W87-08868 2H

Mathematical Model of Seasonal and Spatial Variation in Phosphorus Concentrations in Lake Memphremagog, Quebec,
W87-08899 5B

Seasonality of Legionella Isolates from Environmental Sources,
W87-08902 2H

Algal Phagotrophy: Regulating Factors and Importance Relative to Photosynthesis in Dinobryon (Chrysophyceae),
W87-08929 2H

Lake Loading Ratios (N:P) and Lacustrine Nitrogen Fixation,
W87-08972 2H

Multiattribute Analysis of the Impact on Society of Phosphorus Abatement Measures,
W87-09013 5G

Food of Whitefish (Coregonus lavaretus) in Two Neighbouring Lakes, One Regulated and the Other Natural,
W87-09055 2H

Introduction of Mysis relicta in Sweden: Effects on Fish in Impounded Lakes,
W87-09057 2H

Geochemistry and Ecological Role of Humic Substances in Lakewater,
W87-09071 2H

Atmospheric Lead and Zinc Deposition into Lakes of the Eastern United States,
W87-09183 5B

Theory of Fluorescent Irradiance Fields in Lakes and Seas,
W87-09193 5A

Vulnerability of Selected Lakes and Streams in the Middle Atlantic Region to Acidification: A Regional Survey,
W87-09476 5B

Investigation and Discussion of Techniques for Hypolimnion Aeration/Oxygenation,
W87-09481 5G

Effects of Storage Reallocation on Thermal Characteristics of Cowanesque Lake, Pennsylvania: Numerical Model Investigation,
W87-09485 2H

Developments in LARM2: A Longitudinal-Vertical, Time-Varying Hydrodynamic Reservoir Model,
W87-09489 8B

LAND APPLICATION
Zinc, Copper and Nickel Concentrations in Soil Extracts and Crops Grown on Four Soils Treated with Metal-loaded Sewage Sludges,
W87-09244 5B

Swine Lagoon Effluent Applied to Coastal Bermudagrass,
W87-09472 5D

LAND DISPOSAL
Effects of pH and Soil Type on Concentrations of Zinc, Copper and Nickel Extracted by Calcium Chloride from Sewage Sludge-Treated Soils,
W87-08911 5B

Trace and Nutrient Element Transfer from Sewage Sludge-Amended Soil to Crops: A Study on Brassica oleracea,
W87-08917 5B

Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: I. Persistence, Yield, Quality, and Elemental Removal,
W87-08919 5C

Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: II. Rainfall Runoff and Soil Chemical Properties,
W87-08920 5C

Residual Effects of Sewage Sludge on Soybean: I. Accumulation of Heavy Metals,
W87-08921 5C

Residual Effects of Sewage Sludge on Soybean: II. Accumulation of Soil and Symbiotically Fixed Nitrogen,
W87-08922 5C

Soybean Growth and Boron Distribution in a Sandy Soil Amended with Scrubber Sludge,
W87-08927 5C

Effect of Sewage Sludge on Soil Structural Stability: Microbiological Aspects,
W87-08997 5C

Multiyear Study of Sludge Application to Farmland: Prevalence of Bacterial Enteric Pathogens and Antibody Status of Farm Families,
W87-09394 5C

LAND MANAGEMENT
Effect of Upland Pasture Improvement on Nutrient Release in Flows from a 'Natural' Lysimeter and a Field Drain,
W87-08741 5G

LAND USE
Geochemical Studies in the Drainage Basin of the Rio Vouga, Portugal. IV. Impact of Land Use on the Hydrogeochemistry of Natural Waters in the Vouzela Region,
W87-09207 4C

LANDFILLS
Metal Precipitation in Two Landfill Leachates,
W87-09368 5G

LARVAE
Use of Asiatic Clam Larvae in Aquatic Hazard Evaluations,
W87-09326 5C

LARVAL GROWTH STAGE
Prediction of the Occurrence of Four Species of Mosquito Larvae with Logistic Regression on Water-Chemistry Variables,
W87-08846 2H

Seasonality of Blue Mussel, Mytilus edulis L., Larvae in the Damariscotta River Estuary, Maine, 1969-77,
W87-08849 2L

LATERAL MIXING
Lateral Mixing in Channels Due to Secondary Currents,
W87-08827 2E

LATERAL OUTFLOW
Lateral Outflow over Side Weirs,
W87-09196 8A

LEACHATE
Metal Precipitation in Two Landfill Leachates,
W87-09368 5G

LEACHATES
Groundwater-Leachate: Modeling/Monitoring/Sampling,
W87-09089 5B

Leaching Radioactive and Nonradioactive Elements from Actual Savannah River Plant Nuclear Waste Glass,
W87-09112 5B

LEACHING
Leaching Losses from Irrigated Pasture: Waiau Irrigation Scheme, North Canterbury,
W87-08737 5B

Effect of Upland Pasture Improvement on Nutrient Release in Flows from a 'Natural' Lysimeter and a Field Drain,
W87-08741 5G

Effect of Polluted and Leached Snow Melt Waters on the Soil Bacterial Community--Quantitative Response,
W87-08874 5C

Vacuum Trough Extractors for Measuring Drainage and Nitrate Flux Through Sandy Soils,
W87-08989 7B

Leaching Radioactive and Nonradioactive Elements from Actual Savannah River Plant Nuclear Waste Glass,
W87-09112 5B

Development Programs in the United States of America for the Application of Cement-Based Grouts in Radioactive Waste Management,
W87-09113 5E

Microbially Mediated Leaching of Low-Sulfur Coal in Experimental Coal Columns,
W87-09393 5B

Influence on the Groundwater Conditions in a Multilayered Aquifer System by Alum-Shale Mining,
W87-09570 5C

LEAD
Quantities of Cadmium, Lead, Mercury and Arsenic Entering the U.K. Environment from Human Activities,
W87-08728 5B

Heavy Metals in Lake Kinneret (Israel): II. Hydrogen Sulfide Dependent Precipitation of Copper, Cadmium, Lead and Zinc,
W87-08761 2H

Attenuation of Cd and Pb Solubility in Municipal Waste Incinerator Ash,
W87-08776 5E

Lead Nitrate Induced Changes in the Thyroid Physiology of the Catfish Clarias batrachus (L),
W87-08850 5C

Cadmium and Lead in Lake Ontario Salmonids,
W87-08883 2H

Atmospheric Lead and Zinc Deposition into Lakes of the Eastern United States,
W87-09183 5B

LEAVES
Field Water Relations of a Compass Plant, Lactuca serriola L.,
W87-08772 2I

Leaf Thickness and Water Deficit in Plants: A Tool for Field Studies,
W87-08847 2D

Responses of Leaf Water Potential and Leaf Diffusive Resistance to Abscisic Acid, Water Stress and Low Temperature in Hibiscus esculentus: The Effect of Water Stress and ABA Pre-Treatments,
W87-09210 2D

Water Relations of Xeric Grasses in the Field: Interactions of Mycorrhizzas and Competition,
W87-09341 2I

Responses of Gas Exchange to Humidity in Populations of Three Herbs from Environments Differing in Atmospheric Water,
W87-09346 2I

Changes at Panicle Emergence in the Water Relations of a Wetland and a Dryland Japonica Rice Cultivar Under Wetland Conditions,
W87-09415 2I

LEGAL ASPECTS
Scientific Considerations in the Legislative Arena,
W87-08625 6E

Scientific Considerations in the International Arena,
W87-08626 6E

Regulatory Dilemmas Ensnare Arizona's Small Water Companies,
W87-08952 5F

Hydrogeological Aspects of Agricultural Drainage in Ireland,
W87-09203 2E

Groundwater Management in France,
W87-09205 2F

Economic, Legal, and Hydrologic Dimensions of Potential Interstate Water Markets,
W87-09211 6C

Irrigated Agriculture and Groundwater Quality--A Framework for Policy Development,
W87-09212 6A

LEGIONELLA
Presence of Legionella in London's Water Supplies,
W87-08901 5F

Seasonality of Legionella Isolates from Environmental Sources,
W87-08902 2H

Seasonal Distribution of Legionellae Isolated from Various Types of Water in Israel,
W87-08903 5A

Biocidal Control of Legionellae,
W87-08904 5F

Epidemiological Evidence of Legionellosis Transmission through Domestic Hot Water Supply Systems and Possibilities of Control,
W87-08905 5F

Association between Legionella pneumophila and Amoebae in Water,
W87-08906 5F

Exposure to Legionella in Geriatric Institutions,
W87-08907 5B

Survival and Multiplication of Legionella pneumophila in Municipal Drinking Water Systems,
W87-09389 5F

LEGIONNAIRES' DISEASE
Outbreak of Legionnaires' Disease in Glasgow Royal Infirmary: Microbiological Aspects,
W87-08703 5C

LEGISLATION
Scientific Considerations in the Legislative Arena,
W87-08625 6E

LEGISLATION

Scientific Considerations in the International Arena,
W87-08626 6E

Clean Water Act Update: A New Role for Toxicology,
W87-08627 6E

Environmental Legislation,
W87-09299 6E

LETHAL LIMIT

Acclimation as a Factor Influencing Metal Criteria,
W87-08635 5C

LICHENS

Lichens as Monitors of Atmospheric Deposition,
W87-09181 5C

Water Vapor Uptake and Photosynthesis of Lichens: Performance Differences in Species with Green and Blue-Green Algae as Phycobionts,
W87-09345 2I

LIFE CYCLE STUDIES

Life Cycles of Four Species of Baetis (Ephemeroptera) in Three Danish Streams,
W87-08764 2H

LIFE CYCLES

Comparative Study on the Intrinsic Rates of Increase of Cyrtobagous singularis and C. salviniae on the Water Weed Salvinia molesta,
W87-09217 4A

Early Life Stage Toxicity Tests,
W87-09282 5C

LIGHT ABSORPTION

Absorption of Light by Yellow Substance in Freshwater Lakes,
W87-08934 2H

LIGHT EFFECTS

Influence of Light on Chlorophyll, a Content of Blue-Green Algae Treated with Heavy Metals,
W87-09242 5C

LIGHT PENETRATION

Method for Measuring Selective Light Attenuation within a Periphytic Community,
W87-08769 7B

LIMNOLOGY

Biological Effects of Continuous and Intermittent Dosing of Outdoor Experimental Streams with Chloropyrifos,
W87-08634 5C

Field Confirmation of a Laboratory-Derived Hazard Assessment of the Acute Toxicity of Fenthion to Pink Shrimp, Penaeus duorarum,
W87-08638 5C

Effects of an Acidic River, Caused by Acidic Rain, on Weight Gain, Steroidogenesis, and Reproduction in the Atlantic Salmon (Salmo salar),
W87-08651 5C

Model for Estimating the Loading Rate of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin to the Great Lakes,
W87-08660 5B

Modeling Chemical Transport in Lakes, Rivers, and Estuarine Systems,
W87-08672 5B

Macrofossil and Pollen Representation of Coniferous Trees In Modern Sediments from Washington,
W87-08690 2H

Ecological and Physiological Differentiation Among Low-Arctic Clones of Daphnia Pulex,
W87-08691 2H

Ecological Consequences of Artificial Changes in the Water Regime of Lakes and Their Significance for Forecasting,
W87-08708 6G

Production-Destruction Processes in Ecosystems of Grassy Marshes of the Amur River Region,
W87-08709 2H

Ecological and Statistical Prognosis of the Dynamics of Fish Catch Based on Dendrochronological Data,
W87-08711 2H

Growth and Survival of Giant Ragweed (Ambrosia trifida L.) in a Delaware River Freshwater Tidal Wetland,
W87-08714 2H

Vegetation of the Low-Shrub Bogs of Northern New Jersey and Adjacent New York: Ecosystems at Their Southern Limit,
W87-08715 2H

Nature of Organic Matter in Rivers with Deep Sea Connections: The Ganges-Brahmaputra and Indus,
W87-08721 2H

Heavy Metals in Lake Kinneret (Israel): II. Hydrogen Sulfide Dependent Precipitation of Copper, Cadmium, Lead and Zinc,
W87-08761 2H

Distribution and Relative Abundance of the Nile Perch (Lates niloticus (L.) Pisces: Centropomidae) in Lake Kainji, Nigeria,
W87-08762 2H

Lake Effect on Stream Living Brown Trout (Salmo trutta),
W87-08763 2H

Benthic Macroinvertebrates of the Meuse River in Belgium: A Review of Five Years of Research (1980-1984) (Les Macroinvertebres Benthiques de la Meuse Belge: Bilan de Cinq Annees de Recherches (1980 a 1984),
W87-08765 5C

Three Day Study of the Diel Behaviour of Plankton in a Highly Humic and Steeply Stratified Lake,
W87-08766 2H

1986 Lake Nyos Gas Disaster in Cameroon, West Africa,
W87-08780 2H

Qualitative Model of Eutrophication in Macrophyte Lakes,
W87-08785 2H

Ecological Modelling of a High Mountain Reservoir in Relation to Particulate Organic Matter Loading,
W87-08786 2H

Catchment Effects on the Horizontal Distribution of Phytoplankton in Five of Scotland's Largest Freshwater Lochs,
W87-08790 2H

Comparison of Parasite Fauna of Juvenile Sockeye Salmon (Oncorhynchus Nerka) from Southern British Columbian and Washington State Lakes,
W87-08792 2H

Effects of Food Availability and Fish Predation on a Zooplankton Community,
W87-08799 2H

Temperature and Flow Conditions in a Reservoir with a Submerged Outlet Tunnel During the Winter Period,
W87-08828 2H

Regulation of Submerged Aquatic Plant Distribution in a Uniform Area of a Weedbed,
W87-08836 2H

Hydrology, Water Chemistry and Ecological Relations in the Raised Mound of Cowles Bog,
W87-08837 2H

Hydrodynamics and Structure: Interactive Effects on Meiofauna Dispersal,
W87-08838 2L

Prediction of the Occurrence of Four Species of Mosquito Larvae with Logistic Regression on Water-Chemistry Variables,
W87-08846 2H

Seasonality of Blue Mussel, Mytilus edulis L., Larvae in the Damariscotta River Estuary, Maine, 1969-77,
W87-08849 2L

Internal Waves of the Second Vertical Mode in a Stratified Lake,
W87-08863 2H

Dynamics of Bottom Currents in a Small Lake,
W87-08865 2H

Surface Manifestations of Internal Oscillations in a Highly Saline Lake (the Dead Sea),
W87-08866 2H

Carbon Isotope Fractionation and Changes in the Flux and Composition of Particulate Matter Resulting from Biological Activity during a Sediment Trap Experiment in Lake Greifen, Switzerland,
W87-08867 2H

Free Amino Acids in Lakes: Concentrations and Assimilation Rates in Relation to Phytoplankton and Bacterial Production,
W87-08868 2H

Vertical Transport of Heavy Metals by Settling Particles in Lake Zurich,
W87-08869 5B

Sestonic Bacteria as a Food Source for Filtering Invertebrates in Two Southeastern Blackwater Rivers,
W87-08870 2H

Role of Gas Exchange in the Inorganic Carbon, Oxygen, and 222Rn Budgets of the Amazon River,
W87-08871 2H

Photosynthate Distribution by Microplankton in Permanently Ice-Covered Antarctic Desert Lakes,
W87-08872 2H

Organochlorine Pesticide Residues in Fish from the Shatt al-Arab River, Iraq,
W87-08880 5B

Cadmium and Lead in Lake Ontario Salmonids,
W87-08883 2H

Statistical Assessment of a Sampling Pattern for Evaluation of Changes in Mercury and Zinc Concentrations in Patella coerulea,
W87-08884 5A

Research in Environmental Pollution: II. Determination of Polychlorinated Nitrobenzenes (PCNB's) in Main River Fish,
W87-08895 5A

Mathematical Model of Seasonal and Spatial Variation in Phosphorus Concentrations in Lake Memphremagog, Quebec,
W87-08899 5B

Correlation of a Lake Eutrophication Model to Field Experiments,
W87-08900 2H

Seasonality of Legionella Isolates from Environmental Sources,
W87-08902 2H

Seasonal Distribution of Legionellae Isolated from Various Types of Water in Israel,
W87-08903 5A

Effect of Mosquito Killer Insecticides on Freshwater Mussels,
W87-08908 5C

Contamination of Fish from the French Zone of Lake Leman by Organochlorine Compounds between 1973 and 1981 (Contamination des Poissons du Secteur Francais du Lac Leman, par les Composes Organochlores entre 1973 et 1981),
W87-08909 2H

Residues of Organochlorine Pesticides in Environmental Samples from the Shatt-al-Arab River, Iraq,
W87-08910 5B

Asbestos Fibres Introduce Trace Metals into Streamwater and Sediments,
W87-08912 5B

Algal Phagotrophy: Regulating Factors and Importance Relative to Photosynthesis in Dinobryon (Chrysophyceae),
W87-08929 2H

Ecology of a Cryptomonas phaseolus Population Forming a Metalimnetic Bloom in Lake Ciso, Spain: Annual Distribution and Loss Factors,
W87-08930 2H

Simultaneous Measurement of Primary Production by Whole-Lake and Bottle Radiocarbon Additions,
W87-08931 2H

Sedimentation and Bioturbation in a Salt Marsh as Revealed by 210Pb, 137Cs, and 7Be Studies,
W87-08932 2L

Resuspension in the Shallow Sublittoral Zone of a Macrotidal Estuarine Environment: Wind Influence,
W87-08933 2L

Photosynthesis and Light Adaptation in Epiphyte-Macrophyte Associations Measured by Oxygen Microelectrodes,
W87-08935 7B

Thymidine Incorporation and Microbial Respiration in the Surface Sediment of a Hypereutrophic Lake,
W87-08936 2H

Comparative Effects of Mine Wastes on the Benthos of an Acid and an Alkaline Pond,
W87-08962 5C

Effect of 'Whiting' on Optical Properties and Turbidity in Owasco Lake, New York,
W87-08966 2H

Sedimentation in Lake Onalaska, Navigation Pool 7, Upper Mississippi River, Since Impoundment,
W87-08969 2J

Lake Loading Ratios (N:P) and Lacustrine Nitrogen Fixation,
W87-08972 2H

Spatial Variability in Selected Physical Characteristics and Processes in Cross Lake, New York,
W87-08973 2H

Thermal and Dissolved Oxygen Characteristics of a South Carolina Cooling Reservoir,
W87-08975 2H

Computation of Unsteady Flows in the Alabama River,
W87-08980 2E

Distribution and Abundance of Helice tridens (De Haan) Burrows and Substratum Conditions in a Northeastern Japan Salt Marsh (Crustacea: Brachyura),
W87-08987 2L

Immunological Dietary Analysis of Two Penaeid Shrimp Species from a South Carolina Tidal Creek,
W87-08988 2L

Downward Movement of Partly Degraded Materials in Dyked Marsh Soils,
W87-08998 2H

Regulation of Riverine Fish Communities by a Continuum of Abiotic-Biotic Factors,
W87-09037 2H

Geochemistry and Ecological Role of Humic Substances in Lakewater,
W87-09071 2H

Geochemistry of Humic Substances in Lake Sediments,
W87-09072 2H

Input of Biologically Available Phosphorus by Precipitation to Precambrian Lakes,
W87-09174 5B

Importance of Atmospheric Fluxes to the Nitrogen Balance of Lakes in the Florida Peninsula,
W87-09176 2H

Seasonal Distribution of Thermotolerant Free-Living Amoebae. II. Lake Issaqueena,
W87-09225 2H

Distribution of Particulate Matter in Relation to the Thermal Cycle in Lake Vechten (The Netherlands): The Significance of Transportation Along the Bottom,
W87-09275 2H

Use of Monodispersed, Fluorescently Labeled Bacteria to Estimate In Situ Protozoan Bacterivory,
W87-09388 2H

Limnological Investigations: Lake Koocanusa, Montana; Part 3: Basic Data, Post-Impoundment, 1972-1978,
W87-09463 2H

LIMNOLOYG
Theory of Secondary Production Calculations for Continuously Reproducing Populations,
W87-08862 2L

LINDANE
Impact of Pesticides on Lipid Metabolism in the Freshwater Catfish, Clarias batrachus, during the Vitellogenic Phase of Its Annual Reproductive Cycle,
W87-08851 5C

Pesticide-Induced Changes in Peripheral Thyroid Hormone Levels during Different Reproductive Phases in Heteropneustes fossilis,
W87-08858 5C

Fate of 14C-Lindane in a Rice-Fish Model Ecosystem,
W87-08915 5B

LININGS
New Method for Lining of Field Irrigation Channels,
W87-08750 3F

LIPIDS
Usefulness of the Lipid Index for Bioaccumulation Studies with Daphnia magna,
W87-08652 5C

Impact of Pesticides on Lipid Metabolism in the Freshwater Catfish, Clarias batrachus, during the Vitellogenic Phase of Its Annual Reproductive Cycle,
W87-08851 5C

LIQUID-LIQUID EXTRACTORS
'Spray-Column' Laboratory Apparatus for Organic Matter Extraction from Sludges,
W87-08913 5A

LITERATURE REVIEWS
Environmental Aspects of Energy Related Solid Waste,
W87-09427 5E

LITTLE MIAMI RIVER
Effects of Exposure Time, Season, Substrate Type, and Planktonic Populations on the Taxonomic Composition of Algal Periphyton on Artificial Substrates in the Ohio and Little Miami Rivers, Ohio,
W87-09321 5C

LITTORAL ZONES
Resuspension in the Shallow Sublittoral Zone of a Macrotidal Estuarine Environment: Wind Influence,
W87-08933 2L

LIVER
Xenobiotic-Metabolizing Enzyme Systems in Test Fish: I. Comparative Studies of Liver Microsomal Monooxygenases,
W87-08852 5C

Long-Term Effects of Bleached Kraft Mill Effluents on Carbohydrate Metabolism and Hepatic Xenobiotic Biotransformation Enzymes in Fish,
W87-08854 5C

LOAM
Influence of Long Term Cultural Operations on Physical and Water Retention Characters of a Red Sandy Loam Soil,
W87-08773 2G

LOBSTERS
Cadmium Contamination in American Lobster, Homarus americanus, Near a Coastal Lead Smelter: Use of Multiple Linear Regression for Management,
W87-08882 5C

LOCKS
On-Site Observations of the State of Structures at the Kanev Lock,
W87-09363 7A

LOGGING
Application of Isotope Techniques and Well Loggind in Investigating Ground Water Influenced by Mining,
W87-09580 2F

LOKKA RESERVOIR
Fish Stocks and Fishing in the Lokka and Porttipahta Reservoirs, Northern Finland,
W87-09056 2H

LOLIUM
Physiological Responses to Drought of Lolium perenne L.: Measurement of, and Genetic Variation in, Water Potential, Solute Potential, Elasticity and Cell Hydration,
W87-08848 2D

LONDON
Presence of Legionella in London's Water Supplies,
W87-08901 5F

LONG ISLAND SOUND
Physical and Chemical Behavior and Environmental Acceptability of Stabilized Scrubber Sludge and Fly Ash in Seawater,
W87-09327 5B

Social and Economic Impacts of Selected Potential Dredged Material Containment Facilities in Long Island Sound.
W87-09471 6B

LONG RANGE FORECASTING
Experimental Monthly Long Lange Forecasts for the United Kingdom: Part III. Skill of the Monthly Forecasts.
W87-08701 2B

LOS ANGELES
Recent Developments in the Treatment of Drinking Water with Ozone,
W87-09146 5F

LOTIC ENVIRONMENT
Application of Laboratory Scale Model Streams Toward Assessing Effluent Impacts in Freshwater Lotic Environments,
W87-09314 5C

LOW FLOW
Low Discharge Periods of Rivers in the Upper Vistula River Basin, Poland,
W87-08970 7B

Estimating Baseflow Volume and its Uncertainty,
W87-08971 2E

LUNG
Age-Dependent Lung Doses from Ingested 222Rn in Drinking Water,
W87-08844 5C

LYNGBYA
Systematics and Ecology of Lyngbya spp. and Associated Species (Cyanophyta) in a New England Salt Marsh,
W87-09423 2L

LYSIMETERS
Laboratory Experiment on the Role of Grass for Infiltration and Runoff Processes,
W87-08622 2A

Leaching Losses from Irrigated Pasture: Waiau Irrigation Scheme, North Canterbury,
W87-08737 5B

Effect of Upland Pasture Improvement on Nutrient Release in Flows from a 'Natural' Lysimeter and a Field Drain,
W87-08741 5G

Chemistry of Tension Lysimeter Water and Lateral Flow in Spruce and Hardwood Stands,
W87-08926 5B

MACROFAUNA
Impact of the Esso Bayway Oil Spill on Salt Marsh Macro Fauna,
W87-09550 5C

MACROINVERTEBRATES
Benthic Macroinvertebrates of the Meuse River in Belgium: A Review of Five Years of Research (1980-1984) (Les Macroinvertebres Benthiques de la Meuse Belge: Bilan de Cinq Annees de Recherches (1980 a 1984),
W87-08765 5C

Assessment and Prediction of Impacts of Effluents on Communities of Benthic Stream Macroinvertebrates,
W87-09324 5C

Annual Macroinvertebrate Sampling - A Low-Cost Tool for Ecological Assessment of Effluent Impact,
W87-09325 5C

Effects of Pollution by Organic Sugar Mill Effluent on the Macro-invertebrates of a Stream in Tropical Queensland, Australia,
W87-09421 5C

MACROPHYTES
Qualitative Model of Eutrophication in Macrophyte Lakes,
W87-08785 2H

Photosynthesis and Light Adaptation in Epiphyte-Macrophyte Associations Measured by Oxygen Microelectrodes,
W87-08935 7B

Biological Control of Aquatic Weeds: The Efficacy of Hybrid Grass Carp in Two Southern California Irrigation Canals,
W87-09480 4A

MAINE
Seasonality of Blue Mussel, Mytilus edulis L., Larvae in the Damariscotta River Estuary, Maine, 1969-77,
W87-08849 2L

MAINTENANCE
Hydrogen Sulfide Poisonings in Hot-Spring Reservoir Cleaning: Two Case Reports,
W87-08614 5C

Use of Silica-Fume Concrete to Repair a Stilling Basin,
W87-09413 8F

MALATHION
Impact of Pesticides on Lipid Metabolism in the Freshwater Catfish, Clarias batrachus, during the Vitellogenic Phase of Its Annual Reproductive Cycle,
W87-08851 5C

Pesticide-Induced Changes in Peripheral Thyroid Hormone Levels during Different Reproductive Phases in Heteropneustes fossilis,
W87-08858 5C

MANAGEMENT PLANNING
Water Resources Audit for Small Communities,
W87-08953 5F

MANGANESE
Removal of Iron and Manganese by Ozone during Drinking Water Treatment in Dusseldorf,
W87-09136 5F

MANGROVE SWAMPS
Effects of Oil Spills on Mangrove Forests: A Comparison of Five Oil Spill Sites in the Gulf of Mexico and the Caribbean Sea,
W87-09558 5C

MANUALS
Embankment Dam Instrumentation Manual,
W87-09157 8A

MANURE
Influence of Long Term Cultural Operations on Physical and Water Retention Characters of a Red Sandy Loam Soil,
W87-08773 2G

MAPPING
Mapping the Distribution of Protected and Valuable, Oil-Sensitive Coastal Fish and Wildlife,
W87-09540 7A

Impact and Persistence of Ixtoc I Oil on the South Texas Coast,
W87-09557 5C

Development of a Ground Water Hazard Map for an Underground Coal Mine,
W87-09585 2F

MAPS
Hydrological Maps: Development of a System for Calculation and Presentation,
W87-08812 7C

MARINE BIOLOGY
Hydrodynamics and Structure: Interactive Effects on Meiofauna Dispersal,
W87-08838 2L

MARINE ENVIRONMENT
Theory of Secondary Production Calculations for Continuously Reproducing Populations,
W87-08862 2L

Cadmium Contamination in American Lobster, Homarus americanus, Near a Coastal Lead Smelter: Use of Multiple Linear Regression for Management,
W87-08882 5C

Statistical Assessment of a Sampling Pattern for Evaluation of Changes in Mercury and Zinc Concentrations in Patella coerulea,
W87-08884 5A

Geochemistry of Humin,
W87-09077 2H

Copper in Marine Microlayers: Accumulation, Speciation and Transport,
W87-09172 5B

Petroleum Spills in the Marine Environment: The Chemistry and Formation of Water-in-Oil Emulsions and Tar Balls,
W87-09339 5B

Free Amino Acids in Marine Rains: Evidence for Oxidation and Potential Role in Nitrogen Cycling,
W87-09349 2B

MARINE SEDIMENTS
Mercury Pollution in Marine Sediment Cores Near Cinnabar Deposits and a Chlor-Alkali Plant,
W87-08727 5B

Geochemistry of Humic Substances in Marine Sediments,
W87-09076 2J

Bioaccumulation Potential of Heterotrophic Bacteria for Lead, Selenium, and Arsenic,
W87-09240 5B

Effect of Crude Oil on Microbial Processes in Marine Sediments,
W87-09567 5C

MARINE STRUCTURES
Determination of the Ice Load on Elements of Marine Hydraulic Structures,
W87-09359 8A

MARKETING
Economic, Legal, and Hydrologic Dimensions of Potential Interstate Water Markets,
W87-09211 6C

Irrigated Agriculture and Groundwater Quality--A Framework for Policy Development,
W87-09212 6A

MARSH MANAGEMENT
Examination of Tidal Flats, Vol. 1: Research Report.
W87-09492 4C

MARSH RESTORATION
Restoration of Oiled Marshes Through Sediment Stripping and Spartina Propagation,
W87-09546 5G

MARSHES
Field Confirmation of a Laboratory-Derived Hazard Assessment of the Acute Toxicity of Fenthion to Pink Shrimp, Penaeus duorarum,
W87-08638 5C

Production-Destruction Processes in Ecosystems of Grassy Marshes of the Amur River Region,
W87-08709 2H

Field Survey of Heavy Metal Uptake by Naturally Occurring Saltwater and Freshwater Marsh Plants,
W87-09490 5B

Impact of Oil on Marsh Communities in the St. Lawrence River,
W87-09541 5C

MASS SPECTROMETRY
Determination of Trace Metals in a River Water Reference Material by Inductively Coupled Plasma Mass Spectrometry,
W87-08832 5A

Research in Environmental Pollution: II. Determination of Polychlorinated Nitrobenzenes (PCNB's) in Main River Fish,
W87-08895 5A

MATERIALS TESTING
Development of a Simplified Column Test for Evaluation of Thickness of Capping Material Required to Isolate Contaminated Dredged Material,
W87-09091 5G

MATHEMATICAL ANALYSIS
Programmed Closing of Gates Upon Loss of Drive by a Pump Unit,
W87-09355 8C

MATHEMATICAL ANALYSIS. DAMS
Model of Stability of Revetments of Earth Spillway Slopes,
W87-09357 8D

MATHEMATICAL EQUATIONS
Review of Methods of Parameter Estimation for the Extreme Value Type-1 Distribution,
W87-08619 7C

Theory of Secondary Production Calculations for Continuously Reproducing Populations,
W87-08862 2L

Estimating Baseflow Volume and its Uncertainty,
W87-08971 2E

Steady-State Analysis of Infiltration and Overland Flow for Spatially-Varied Hillslopes,
W87-08974 2E

Slope Gradient Effect on Erosion of Reshaped Spoil,
W87-09000 2J

Capillarity Correction for Free Surface Flow of Groundwater,
W87-09018 2F

Quasi-Solution of Richards' Equation for the Downward Infiltration of Water into Soil,
W87-09019 2G

MATHEMATICAL MODELS
Environmental Exposure from Chemicals.
W87-08670 5B

Environmental Systems Analysis: An Overview,
W87-08671 5B

Modeling Chemical Transport in Lakes, Rivers, and Estuarine Systems,
W87-08672 5B

Numerical Simulation of the Effects of Varying Ice Crystal Nucleation Rates and Aggregation Processes on Orographic Snowfall,
W87-08697 2B

Analysis of Horizontally Two-Dimensional Morphological Evolutions in Shallow Water,
W87-08782 7C

Theory of Secondary Production Calculations for Continuously Reproducing Populations,
W87-08862 2L

Mathematical Model of Seasonal and Spatial Variation in Phosphorus Concentrations in Lake Memphremagog, Quebec,
W87-08899 5B

Correlation of a Lake Eutrophication Model to Field Experiments,
W87-08900 2H

Desk-Top Methods for Urban Stormwater Calculation,
W87-09100 2A

Urban Runoff Processes,
W87-09101 2A

Quality of Urban Runoff,
W87-09102 5B

Groundwater Transport: Handbook of Mathematical Models,
W87-09306 5B

Effects of Storage Reallocation on Thermal Characteristics of Cowanesque Lake, Pennsylvania: Numerical Model Investigation,
W87-09485 2H

Kahului Breakwater Stability Study, Kahului, Maui, Hawaii: Hydraulic Model Investigation,
W87-09488 8B

Developments in LARM2: A Longitudinal-Vertical, Time-Varying Hydrodynamic Reservoir Model,
W87-09489 8B

Influence on the Groundwater Conditions in a Multilayered Aquifer System by Alum-Shale Mining,
W87-09570 5C

MATHEMATICAL STUDIES
Review of Methods of Parameter Estimation for the Extreme Value Type-1 Distribution,
W87-08619 7C

Hydrology,
W87-08662 2A

Environmental Systems Analysis: An Overview,
W87-08671 5B

Pollutant Sorption in Environmental Systems,
W87-08677 5B

Air/Soil Exchange Coefficients,
W87-08678 5B

Air/Water Exchange Coefficients,
W87-08679 5B

Stability and Instability of an Adaptive Resource Replacement Strategy in and Agroecological Production System,
W87-08784 6A

Understanding the Origin of Radon Indoors--Building a Predictive Capability,
W87-08888 5B

Simulation of the Hydrologic Cycle for Watersheds,
W87-09111 2A

Determination of Maximum Design Discharges,
W87-09362 2E

Spectral Analysis of Columbia River Estuary Currents,
W87-09430 2L

Kahului Breakwater Stability Study, Kahului, Maui, Hawaii: Hydraulic Model Investigation,
W87-09488 8B

MATRIC POTENTIAL
Field Method for Estimating Hydraulic Conductivity and Matric Potential-Water Content Relations,
W87-08993 2G

MAXEY FLATS WASTE DISPOSAL SITE
Trees as Indicators of Subterranean Water Flow from a Retired Radioactive Waste Disposal Site,
W87-08845 5A

MEASURING INSTRUMENTS
Relative Accuracy of Satellite and Raingage Rainfall Measurements over Middle Latitudes during Daylight Hours,
W87-08700 2B

Bare Soil Evaporation Near a Surface Point-Source Emitter,
W87-08743 2D

Temporal Observations of Surface Soil Moisture Using A Passive Microwave Sensor,
W87-08781 2G

Measurement of Soil Water Content Using the Combined Time-Domain Reflectometry - Thermal Conductivity Probe,
W87-08796 2G

Determination of Trace Metals in a River Water Reference Material by Inductively Coupled Plasma Mass Spectrometry,
W87-08832 5A

Leaf Thickness and Water Deficit in Plants: A Tool for Field Studies,
W87-08847 2D

'Spray-Column' Laboratory Apparatus for Organic Matter Extraction from Sludges,
W87-08913 5A

Photosynthesis and Light Adaptation in Epiphyte-Macrophyte Associations Measured by Oxygen Microelectrodes,
W87-08935 7B

Tropical Squall Line Observed During the COPT 81 Experiment in West Africa. Part I: Kinematic Structure Inferred from Dual-Doppler Radar Data,
W87-08939 2B

Theory and Practice in the Electrometric Determination of pH in Precipitation,
W87-08949 7B

Chromatographic Studies of Dissolved Organic Matter and Copper-Organic Complexes Isolated From Estuarine Waters,
W87-08960 7B

Digital Controller for Discrete Stage Activation of Automatic Pumping Samplers,
W87-08983 7B

Vacuum Trough Extractors for Measuring Drainage and Nitrate Flux Through Sandy Soils,
W87-08989 7B

Pulsed Nuclear Magnetic Resonance Instrument for Soil-Water Content Measurement: Sensor Configurations,
W87-08991 7B

Field Method for Estimating Hydraulic Conductivity and Matric Potential-Water Content Relations,
W87-08993 2G

Method to Estimate Soil Loss From Erosion,
W87-09007 7B

Semiportable Multislot Divisor for Erosion and Runoff Measurements,
W87-09010 7B

MEASURING INSTRUMENTS

Gas Chromatographic Analysis of Volatile Compounds in Water and Biological Samples with an Automatic Injector,
W87-09012 7B

Determination of Toxic Organophosphorus Compounds by Specific and Nonspecific Detectors,
W87-09220 5A

Stroboscopic Determination of Settling Velocity, Size and Porosity of Activated Sludge Flocs,
W87-09263 7B

Instrumentation for Environmental Monitoring, Volume 2: Water,
W87-09303 5A

On-Site Observations of the State of Structures at the Kanev Lock,
W87-09363 7A

Measurement of Water Potential in Low-Level Waste Management,
W87-09456 7B

MEDITERRANEAN BASIN

Pasture and Forest Management in the Mediterranean Uplands,
W87-08665 3F

MEMBRANE FILTERS

Concentration of Giardia Cysts from Water by a Centrifugal Cream Separator,
W87-09209 5A

MEMBRANE PROCESSES

Applications of Porous Membranes for Biomass Retention in Biological Wastewater Treatment Processes,
W87-08889 5D

MEMBRANES

Spectrophotometric Determination of Traces of Silicon in Water after Collection as Silicomolybdenum Blue on an Organic-Solvent-Soluble Membrane Filter,
W87-08833 5A

MENIDIA

Effects of Triethylene Glycol on Mysidopsis bahia (Crustacea: Mysidacea) and Menidia peninsulae (Pisces: Atherinidae),
W87-08644 5C

MEPHOSFOLAN

Effect of Irrigation on Persistent Toxicity of Insecticides Applied as Granules to Soil to Brown Plant Hopper and Rice Swarming Caterpillar,
W87-08897 5B

MERCURY

Separation of Mercury from Aqueous Mercuric Chloride Solutions by Onion Skins,
W87-08606 5D

Mercury Pollution in Marine Sediment Cores Near Cinnabar Deposits and a Chlor-Alkali Plant,
W87-08727 5B

Quantities of Cadmium, Lead, Mercury and Arsenic Entering the U.K. Environment from Human Activities,
W87-08728 5B

Transport of Arsenic and Mercury from Gold Mining Activities Through an Aquatic System,
W87-08731 5B

Determination of Cobalt, Copper, Mercury, and Nickel as Bis(2-hydroxyethyl)dithiocarbamate Complexes by High-Performance Liquid Chromatography,
W87-08831 5A

Statistical Assessment of a Sampling Pattern for Evaluation of Changes in Mercury and Zinc Concentrations in Patella coerulea,
W87-08884 5A

Concentrations of Mercury in Near Shore Surface Waters of the Bay of Biscay and in the Gironde Estuary,
W87-08961 5A

MESEMBRYANTHEMUM

Induction of Crassulacean Acid Metabolism in Mesembryanthemum crystallinum by High Salinity: Mass Increase and de Novo Synthesis of PEP-Carboxylase,
W87-09418 3C

MESOSCALE SYSTEMS

Impact of Mesoscale Convective Systems on Regional Visibility and Oxidant Distributions during Persistent Elevated Pollution Episodes,
W87-08695 2B

MESOTROPHIC LAKES

Regulation of Submerged Aquatic Plant Distribution in a Uniform Area of a Weedbed,
W87-08836 2H

METABOLISM

Impact of Pesticides on Lipid Metabolism in the Freshwater Catfish, Clarias batrachus, during the Vitellogenic Phase of Its Annual Reproductive Cycle,
W87-08851 5C

Xenobiotic-Metabolizing Enzyme Systems in Test Fish: I. Comparative Studies of Liver Microsomal Monooxygenases,
W87-08852 5C

Long-Term Effects of Bleached Kraft Mill Effluents on Carbohydrate Metabolism and Hepatic Xenobiotic Biotransformation Enzymes in Fish,
W87-08854 5C

Comparative Metabolism of Fenitrothion in Aquatic Organisms: I. Metabolism in the Euryhaline Fish, Oryzias latipes and Mugil cephalus,
W87-08859 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: II. Metabolism in the Freshwater Snails, Cipangopaludina japonica and Physa acuta,
W87-08860 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: III. Metabolism in the Crustaceans, Daphnia pulex and Palaemon paucidens,
W87-08861 5B

Kinetic Models for Predicting Bioaccumulation of Pollutants in Ecosystems,
W87-09247 5B

METAL ORGANIC PESTICIDES

Acute Toxicity of Brestan and Fentin Acetate on Some Freshwater Organisms,
W87-08876 5C

METALS

Some Metals and Their Possible Sources in Rain Water of the Southern Baltic Coast, 1976 and 1978-1980,
W87-08726 5B

Determination of Trace Metals in a River Water Reference Material by Inductively Coupled Plasma Mass Spectrometry,
W87-08832 5A

Evaluation of Natural Tracers in an Acidic and Metal-Rich Stream,
W87-09021 7B

Use of Bog Vegetation as a Monitor of Atmospheric Input of Metals,
W87-09182 5C

Removal of Multivalent Metal Cations from Water Using Micellular-Enhanced Ultrafiltration,
W87-09223 2K

Response of Lake Sediments to Changes in Trace Metal Emission from the Smelters at Sudbury, Ontario,
W87-09245 5B

Field Survey of Heavy Metal Uptake by Naturally Occurring Saltwater and Freshwater Marsh Plants,
W87-09490 5B

METEOROLOGICAL DATA COLLECTION

Rainfall in the Wet-Dry Tropics: Extreme Events at Darwin and Similarities Between Years During the Period 1870-1983 Inclusive,
W87-08775 2B

METEOROLOGY

Snow Forecasts from the Meteorlogical Office Fine-mesh Model During the Winter of 1985/86,
W87-08702 2B

Water Vapor Transport Over the Indian Ocean During the 1979 Summer Monsoon. Part I: Water Vapor Fluxes,
W87-08937 2B

Consistent Parameterization of the Effects of Cumulus Clouds on the Large-Scale Momentum and Vorticity Fields,
W87-08938 2B

Tropical Squall Line Observed During the COPT 81 Experiment in West Africa. Part I: Kinematic Structure Inferred from Dual-Doppler Radar Data,
W87-08939 2B

Empirical Prediction of the Summer Monsoon Rainfall over India,
W87-08940 2B

Analysis of the Impact of the Sudbury Smelters on Wet and Dry Deposition in Ontario,
W87-08942 5B

Rainfall Acidity as Related to Meteorological Parameters in Northern Quebec,
W87-08943 2B

Canadian Atlantic Storms Program: The Meteorological Field Project,
W87-09255 2B

METEOROLOGY *STATISTICAL ANALYSIS

SCPP Meteorological and Statistical Support for Period 1 September 1985, 31 August 1986, Volume I: Interim Progress Report,
W87-09334 2B

METEROLOGICAL DATA COLLECTION

Data Intercomparison Theory I. Minimal Spanning Tree Tests for Location and Scale Differences,
W87-09501 7C

Data Intercomparison Theory V. Case Study: Effects of Objective Analysis on a Tropical Pacific Sea Surface Temperature Set,
W87-09502 7C

Data Intercomparison Theory IV. Tercile Tests for Location, Spread and Pattern Differences,
W87-09503 7C

Data Intercomparison Theory II. Trinity Statistics for Location, Spread and Pattern Differences,
W87-09504 7C

Data Intercomparison Theory III. S-Phase and T-Phase Tests for Spatial Pattern and Temporal Evolution,
W87-09505 7C

METHANE

Interrelationships of Algae and Bacteria During Methane Oxidation,
W87-08712 2H

Anaerobic Treatment of Distillery Slops Using an Upflow Anaerobic Filter Reactor,
W87-08890 5D

Methane Recovery from Water Hyacinth Through Whole-Cell Immobilization Technology,
W87-09420 5D

METHANE BACTERIA

Methanogenic Toxicity and Anaerobic Degradability of a Hydrolyzable Tannin,
W87-09278 5D

METHYL MERCAPTIDES

Ammonia, Hydrogen Sulphide and Methyl Mercaptides in Finnish Municipal Sewage Plants and Pumping Stations,
W87-08725 5D

METHYLMERCURY

In Vitro Cytotoxicity of Organic Pollutants to Bluegill Sunfish (BF-2) Cells,
W87-08843 5C

METROPOLITAN WATER MANAGEMENT

Metropolitan Water Management,
W87-09338 6D

MEUSE RIVER

Benthic Macroinvertebrates of the Meuse River in Belgium: A Review of Five Years of Research (1980-1984) (Les Macroinvertebres Benthiques de la Meuse Belge: Bilan de Cinq Annees de Recherches (1980 a 1984),
W87-08765 5C

MICHIGAN

Ecological Factors in the Selection of Representative Species for Thermal Effluent Demonstrations,
W87-09315 5C

MICROBIAL RESPIRATION

Thymidine Incorporation and Microbial Respiration in the Surface Sediment of a Hypereutrophic Lake,
W87-08936 2H

MICROBILOGICAL STUDIES

Outbreak of Legionnaires' Disease in Glasgow Royal Infirmary: Microbiological Aspects,
W87-08703 5C

MICROBIOLOGICAL STUDIES

Seasonality of Legionella Isolates from Environmental Sources,
W87-08902 2H

Association between Legionella pneumophila and Amoebae in Water,
W87-08906 5F

Committee Report: Microbiological Considerations for Drinking Water Regulation Revisions,
W87-08959 5F

Effect of Sewage Sludge on Soil Structural Stability: Microbiological Aspects,
W87-08997 5C

Microbial Toxicity Studies,
W87-09287 5C

Potential for Transduction of Plasmids in a Natural Freshwater Environment: Effect of Plasmid Donor Concentration and a Natural Microbial Community on Transduction in Pseudomonas aeruginosa,
W87-09390 2H

Maintenance and Stability of Introduced Genotypes in Groundwater Aquifer Material,
W87-09391 5B

MICROELECTRODES

Photosynthesis and Light Adaptation in Epiphyte-Macrophyte Associations Measured by Oxygen Microelectrodes,
W87-08935 7B

MICROFLOCCULATION

Microflocculation by Ozone,
W87-09142 5F

MICROWAVE SENSORS

Temporal Observations of Surface Soil Moisture Using A Passive Microwave Sensor,
W87-08781 2G

MIGRATION

Hydrodynamics and Structure: Interactive Effects on Meiofauna Dispersal,
W87-08838 2L

MINE DRAINAGE

Hydrological and Chemical Factors Controlling the Concentrations of Fe, Cu, Zn and As in a River System Contaminated by Acid Mine Drainage,
W87-09277 5B

Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I and II.
W87-09568 2F

Role of Hydrogeology in Coal Mining Near Chandrapur in Maharashtra, India,
W87-09569 2F

Mine Drainage Problems in Indian Coalfields, with Special Reference to the Problems in Jharia Coalfield,
W87-09571 4C

Influence of Structure on Underground Water Prediction and Occurrence at Rokana Mine, Kitwe, Zambia,
W87-09572 2F

Hydrogeology of Underground Coal Mines in Illinois,
W87-09573 2F

Exploitation and Control of Karst Water in Coal Measures,
W87-09575 2F

Hydrogeologic Factors that May Affect Mine Drainage in the Anthracite Region of Pennsylvania, Eastern United States,
W87-09577 4C

Proposed Hydrogeological Model for Future Lignite Mining and Groundwater Drainage in the Hula Basin, Northern Israel,
W87-09578 2F

Preliminary Hydrogeological Study of the Reocin Mine (Santander, Spain) (Estudio Hidrogeologico Preliminar de la Mina de Reocin (Santander, Espana)),
W87-09579 2F

Application of Isotope Techniques and Well Loggind in Investigating Ground Water Influenced by Mining,
W87-09580 2F

Groundwater Control in Opencast Mining of a Lignite Deposit in Southern Greece,
W87-09583 4B

Mine and Open Pit Dewatering at Chingola, Zambia,
W87-09584 4B

Origin and Dynamics of the Waters Flowing into the Mining Works in Reocin (Santander, Spain) (Sobre el Origen y Dinamica de las Aguas Fluyentes a las Explotaciones Mineras de Reocin (Santander, Espana)),
W87-09586 2F

Hydrogeological Aspects of Coal Mining Under Stored Waters Near Sydney, Australia,
W87-09587 2F

Water Hazard in Deep Gold Mining of the Far West Witwatersrand - South Africa,
W87-09588 2F

Plans and Experiments to Deal with Large Amounts of Sediment in Hungarian Mines under Karstic Water Hazard,
W87-09590 4C

Problems of Water Inrush into Greek Underground Mines with Special Emphasis to Sea Water Inrush Through Karstic Limestones or Impermeable Formations,
W87-09596 2F

Some Hydrogeological Solutions to the Exploitation of Underground Lignite Mines (Quelques Solutions Hydrogeologiques dans la Construction des Mines de Lignite Souterraines),
W87-09597 4B

Special Techniques of Ground Treatment in Mining Works (Las Tecnicas Especiales de Tratamiento del Terreno en los Trabajos de Mineria),
W87-09598 4B

Forecasting the Rates of Water Inflowing into Mines,
W87-09599 2F

Water Control Strategy of Mines Under Strong Karstic Water Hazard,
W87-09600 4B

Piezometric Level in Fissure Areas (Le Niveau Piezometrique dans les Zones de Diaclases),
W87-09601 2F

MINE WASTES

Use of the Pocketbook Mussel, Lampsilis ventricosa, for Monitoring Heavy Metal Pollution in an Ozark Stream,
W87-08875 5A

Comparative Effects of Mine Wastes on the Benthos of an Acid and an Alkaline Pond,
W87-08962 5C

Slope Gradient Effect on Erosion of Reshaped Spoil,
W87-09000 2J

Microbially Mediated Leaching of Low-Sulfur Coal in Experimental Coal Columns,
W87-09393 5B

Environmental Aspects of Energy Related Solid Waste,
W87-09427 5E

Leaching Behaviors of Low-Sulfur Coals and Coal Wastes from Three Western Coal Preparation Plants,
W87-09429 5B

Scale-Up of a Radium-226 Removal Process,
W87-09448 5D

Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I and II.
W87-09568 2F

Influence on the Groundwater Conditions in a Multilayered Aquifer System by Alum-Shale Mining,
W87-09570 5C

Special Techniques of Ground Treatment in Mining Works (Las Tecnicas Especiales de Tratamiento del Terreno en los Trabajos de Mineria),
W87-09598 4B

MINERALIZATION
Geochemistry, Soils and Cardiovascular Diseases,
W87-08692 2F

Dynamics of Nitrogen and Carbon in Soil during Papermill Sludge Decomposition,
W87-08891 5E

MINERALS
Mineral Content of Grasses and Grasslands of the Himalayan Region: 2. Concentration of Trace and Major Elements in Grasses in Relation to Soil Properties and Climatic Factors,
W87-09256 2I

MINING ENGINEERING
Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I and II.
W87-09568 2F

Mine Drainage Problems in Indian Coalfields, with Special Reference to the Problems in Jharia Coalfield,
W87-09571 4C

Influence of Structure on Underground Water Prediction and Occurrence at Rokana Mine, Kitwe, Zambia,
W87-09572 2F

Hydrogeology of Underground Coal Mines in Illinois,
W87-09573 2F

Exploitation and Control of Karst Water in Coal Measures,
W87-09575 2F

Proposed Hydrogeological Model for Future Lignite Mining and Groundwater Drainage in the Hula Basin, Northern Israel,
W87-09578 2F

Preliminary Hydrogeological Study of the Reocin Mine (Santander, Spain) (Estudio Hidrogeologico Preliminar de la Mina de Reocin (Santander, Espana)),
W87-09579 2F

Groundwater Control in Opencast Mining of a Lignite Deposit in Southern Greece,
W87-09583 4B

Mine and Open Pit Dewatering at Chingola, Zambia,
W87-09584 4B

Development of a Ground Water Hazard Map for an Underground Coal Mine,
W87-09585 2F

Water Hazard in Deep Gold Mining of the Far West Witwatersrand - South Africa,
W87-09588 2F

High Pressure Grouting in Deep Gold Mines,
W87-09592 4B

British Examples of a Hydrogeological Approach to the Evaluation of Drainage Problems in Subsurface Engineering,
W87-09593 2F

Problems of Water Inrush into Greek Underground Mines with Special Emphasis to Sea Water Inrush Through Karstic Limestones or Impermeable Formations,
W87-09596 2F

Some Hydrogeological Solutions to the Exploitation of Underground Lignite Mines (Quelques Solutions Hydrogeologiques dans la Construction des Mines de Lignite Souterraines),
W87-09597 4B

Special Techniques of Ground Treatment in Mining Works (Las Tecnicas Especiales de Tratamiento del Terreno en los Trabajos de Mineria),
W87-09598 4B

Forecasting the Rates of Water Inflowing into Mines,
W87-09599 2F

Water Control Strategy of Mines Under Strong Karstic Water Hazard,
W87-09600 4B

MINNESOTA
Humic Substances in Groundwater,
W87-09070 2F

Trace Metal and Strong Acid Composition of Rain and Snow in Northern Minnesota,
W87-09178 5B

Impacts of a Spill of No. 6 Fuel Oil on Lake Winona,
W87-09551 5C

MINNOWS
Acute and Chronic Toxicity to the Fathead Minnow, Pimephales promelas, of Effluents from a Treatment Plant Receiving Dye and Pigment Processing Wastewater,
W87-08656 5C

Bioconcentration of Four Chlorinated Dioxins by Rainbow Trout and Fathead Minnows,
W87-08659 5B

Effects of Lowered Dissolved Oxygen Concentration on the Toxicity of 1,2,4-Trichlorobenzene to Fathead Minnows,
W87-08879 5C

Comparison of Toxicity Tests Conducted in the Laboratory and in Experimental Ponds using Cadmium and the Fathead Minnow (Pimephales promelas),
W87-09272 5C

MISCIBLE DISPLACEMENT
Kinetics of Sulfate Adsorption and Desorption by Cecil Soil Using Miscible Displacement,
W87-08995 2G

MISSISSIPPI RIVER
Sedimentation in Lake Onalaska, Navigation Pool 7, Upper Mississippi River, Since Impoundment,
W87-08969 2J

Mathematical Study of the Impact on Salinity Intrusion of Deepening the Lower Mississippi River Navigation Channel,
W87-09095 5B

MISSOURI
Environmental Mobility of Dioxins,
W87-08658 5B

MITES
Impact-Sensitiveness of Soil Oribatid Species to the Waste Water from a Coal Distillation Plant,
W87-08898 5A

MIXING
Lateral Mixing in Channels Due to Secondary Currents,
W87-08827 2E

Resuspension in the Shallow Sublittoral Zone of a Macrotidal Estuarine Environment: Wind Influence,
W87-08933 2L

Perspectives on the Scale-Up of Impeller Mixers,
W87-09434 5D

MODEL ECOSYSTEMS
Fate of 14C-Lindane in a Rice-Fish Model Ecosystem,
W87-08915 5B

MODEL IMPROVEMENT
Operational Spring Time Forecasting Difficulties and Improvements,
W87-08824 2E

Transformation of Input to a Stochastic Model Using a Distribution Deterministic Model,
W87-08825 2E

MODEL STUDIES
2-D Elastoplastic Seismic Shear Response of Earth Dams: Theory,
W87-08607 8A

2-D Elastoplastic Seismic Shear Response of Earth Dams: Applications,
W87-08608 8A

Estimation of Groundwater Recharge in Sandy Till with Two Different Methods Using Groundwater Level Fluctuations,
W87-08615 2F

Unsteady Flow to Wells in Layered and Fissured Aquifer Systems,
W87-08618 2F

Finite Element Analysis of Water Flow in Variably Saturated Soil,
W87-08620 2G

Application of Meteorological Radar Data for Simulation of Streamflow with a Hydrological Matrix Model (Utilisation des Donnees d'un Radar Meteorologique pour la Simulation des Ecoulements en Riviere a l'aide d'un Modele Hydrologique Matriciel),
W87-08623 7B

Acute Toxicity of Chlorine on Freshwater Organisms: Time-Concentration Relationships of Constant and Intermittent Exposures,
W87-08640 5C

Environmental Mobility of Dioxins,
W87-08658 5B

Model for Estimating the Loading Rate of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin to the Great Lakes,
W87-08660 5B

Environmental Exposure from Chemicals.
W87-08670 5B

Environmental Systems Analysis: An Overview,
W87-08671 5B

Modeling Chemical Transport in Lakes, Rivers, and Estuarine Systems,
W87-08672 5B

Nonpoint Source Pollution Models for Chemicals,
W87-08673 5B

Environmental Exposure from Chemicals.
W87-08675 5B

Pollutant Sorption in Environmental Systems,
W87-08677 5B

Equilibrium Models for the Initial Integration of Physical and Chemical Properties,
W87-08683 5B

Introduction to Groundwater Modeling: Finite Difference and Finite Element Methods,
W87-08684 2F

Point Probability Distributions of Frozen Soil,
W87-08696 2C

Numerical Simulation of the Effects of Varying Ice Crystal Nucleation Rates and Aggregation Processes on Orographic Snowfall,
W87-08697 2B

Snow Forecasts from the Meteorlogical Office Fine-mesh Model During the Winter of 1985/86,
W87-08702 2B

Soil Water Balance Model for Sloping Land,
W87-08735 2A

Linear Regression Model Combined with a Soil Water Balance Model to Design Micro-Catchments for Water Harvesting in Arid Zones,
W87-08738 3B

Estimating Water Table Contribution to the Water Supply of Maize,
W87-08740 3F

Surge Irrigation Management,
W87-08744 3F

Diffusivity of a Glacial-Outwash Aquifer by the Floodwave-Response Technique,
W87-08754 2F

Impact of the Dupuit-Forchheimer Approximation on Salt-Water Intrusion Simulation,
W87-08758 2F

Performance and Analysis of Aquifer Tracer Tests with Implications for Contaminant Transport Modeling - A Project Summary,
W87-08759 5B

Predictive Application of an ORNL Geohydrology Model,
W87-08760 7C

Analysis of Horizontally Two-Dimensional Morphological Evolutions in Shallow Water,
W87-08782 7C

Model for Predicting the Influence of Moisture Stress on Crop Losses Caused by Ozone,
W87-08783 2I

Stability and Instability of an Adaptive Resource Replacement Strategy in and Agroecological Production System,
W87-08784 6A

Qualitative Model of Eutrophication in Macrophyte Lakes,
W87-08785 2H

Ecological Modelling of a High Mountain Reservoir in Relation to Particulate Organic Matter Loading,
W87-08786 2H

Temperature Modelling of Wet and Dry Desert Soils,
W87-08791 2G

Correction of Liquid Precipitation,
W87-08813 2B

Estimation of Canopy Reservoir Capacity and Oxygen-18 Fractionation in Throughfall in a Pine Forest,
W87-08814 2B

Spatial Variability of Soil Water and Evapotranspiration,
W87-08815 2G

Modelling of Unsaturated Flow in Heterogeneous Soils Part I: Deterministic Simulations of Water Flow in Soil Profiles,
W87-08816 2G

Modelling of Unsaturated Flow in Heterogeneous Soils Part II: Stochastic Simulation of Water Flow Over a Field,
W87-08817 2G

Stochastic Modelling of a Contaminated Aquifer: The Unconditional Approach,
W87-08820 5B

Modelling Water Exchange and Transit Times in Till Basins Using Oxygen-18,
W87-08821 2A

Operational Spring Time Forecasting Difficulties and Improvements,
W87-08824 2E

Transformation of Input to a Stochastic Model Using a Distribution Deterministic Model,
W87-08825 2E

Groundwater Modelling for Hydropower Development in Iceland,
W87-08829 2F

Prediction of the Occurrence of Four Species of Mosquito Larvae with Logistic Regression on Water-Chemistry Variables,
W87-08846 2H

Volatilization Loss of Nitrogen from Submerged Saline Soil,
W87-08892 2G

Mathematical Model of Seasonal and Spatial Variation in Phosphorus Concentrations in Lake Memphremagog, Quebec,
W87-08899 5B

Fate of 14C-Lindane in a Rice-Fish Model Ecosystem,
W87-08915 5B

Soil Clogging During Subsurface Wastewater Infiltration as Affected by Effluent Composition and Loading Rate,
W87-08928 5C

Sedimentation and Bioturbation in a Salt Marsh as Revealed by 210Pb, 137Cs, and 7Be Studies,
W87-08932 2L

Consistent Parameterization of the Effects of Cumulus Clouds on the Large-Scale Momentum and Vorticity Fields,
W87-08938 2B

Air-Water Phase Equilibria of Volatile Organic Solutes,
W87-08956 5F

Allocation Model for Irrigation Water Cost: Case Study of the Nile Valley in Egypt,
W87-08968 6C

Computation of Unsteady Flows in the Alabama River,
W87-08980 2E

Velocity Control as a Tool for Optimal Plume Containment in the Equus Beds Aquifer, Kansas,
W87-08982 5G

Alternative Demand Model Estimators for Block Rate Pricing,
W87-08984 6C

Accuracy of Selective Extraction Procedures for Metal Speciation in Model Aquatic Sediments,
W87-08985 5A

Solute Transport During Absorption and Infiltration: A Comparison of Analytical Approximations,
W87-08990 7C

Analysis of Volume Change in Unconfined Units of Soil,
W87-08992 2G

Elimination of Time Assignment Bias in Estimates of Dispersion Coefficient,
W87-08994 7C

Production Functions for Water Delivery Systems: Analysis and Estimation Using Dual Cost Function and Implicit Price Specifications,
W87-09014 6D

Stochastic Model for Sediment Yield Using the Principle of Maximum Entropy,
W87-09016 2J

Mobilization of Aluminum in a Natural Soil System: Effects of Hydrologic Pathways,
W87-09024 5B

Markov Renewal Model for Rainfall Occurrences,
W87-09025 7C

Statistical Modeling of Daily Rainfall Occurrences,
W87-09026 7C

Synthesis of a Simplified Water Use Simulation Model for Predicting Wheat Yields,
W87-09028 2I

Exploring Existence Value,
W87-09031 6C

Valuing Wildlife in Benefit-Cost Analyses: A Case Study Involving Endangered Species,
W87-09032 6B

Estimating the Value of Water Quality Improvements in a Recreational Demand Framework,
W87-09033 6C

Modeling the Demand for Outdoor Recreation,
W87-09034 6D

Regulation of Riverine Fish Communities by a Continuum of Abiotic-Biotic Factors,
W87-09037 2H

Effect of Recreational Uses Upon Aquatic Ecosystems and Fish Resources,
W87-09060 6G

Groundwater-Leachate: Modeling/Monitoring/Sampling,
W87-09089 5B

Economic Differences Between Cumulative and Episodic Reduction of Sediment from Cropland,
W87-09090 2J

Photolytic Ozonation for Protection and Rehabilitation of Ground-Water Resources; A Mechanistic Study,
W87-09092 5G

Mathematical Study of the Impact on Salinity Intrusion of Deepening the Lower Mississippi River Navigation Channel,
W87-09095 5B

Overview of Urban Stormwater Models,
W87-09104 4C

Example Model Applications,
W87-09105 4C

Determining Optimum Pumping Rates for Creation of Hydraulic Barriers to Ground-Water Pollutant Migration,
W87-09108 5G

Modeling of Atmospheric Wet Deposition,
W87-09165 5B

Modeling of Atmospheric Particulate Deposition to Natural Waters,
W87-09166 5B

Exchange of Particles and Gases Across Water Surfaces,
W87-09168 5B

Principles and Problems of Modeling Cation Enrichment at Natural Air-Water Interfaces,
W87-09170 5B

Transport and Dry Deposition of Trace Metals over Southern Lake Michigan,
W87-09179 5B

Atmospheric Concentrations and Deposition of Polychlorinated Biphenyls to Lake Superior,
W87-09185 5B

Adsorption of Inorganic Pollutants in Aquatic Systems,
W87-09194 5B

Fish Diversion in Hydropower Intake,
W87-09197 8I

Kinetic Models for Predicting Bioaccumulation of Pollutants in Ecosystems,
W87-09247 5B

Subglacial Drainage for an Ice Sheet Resting Upon a Layered Deformable Bed,
W87-09248 2F

Modeling the Flow of Immiscible Fluids in Soils,
W87-09258 2G

Modelling of BOD-DO Dynamics in an Ice-Covered River in Northern China,
W87-09262 5B

Fate Modeling,
W87-09298 5B

Groundwater Transport: Handbook of Mathematical Models,
W87-09306 5B

Application of Laboratory Scale Model Streams Toward Assessing Effluent Impacts in Freshwater Lotic Environments,
W87-09314 5C

Prehistoric Cultural Resources Study Predictive Model and Field Survey Weber Basin Project,
W87-09335 6G

Model of Stability of Revetments of Earth Spillway Slopes,
W87-09357 8D

Biofilm Shearing Under Dynamic Conditions,
W87-09367 5D

Prediction of Fixed-Bed Adsorber Removal of Organics in Unknown Mixtures,
W87-09369 5D

Expansion of Granular Filters During Backwashing,
W87-09371 5D

Comparison of Backwash Models for Granular Media,
W87-09372 5D

Wastewater-Induced Soil Clogging Development,
W87-09373 5C

Optimal Water Treatment Plant Design,
W87-09374 5F

Modeling Coliform Bacteria Subject to Chlorination,
W87-09375 5D

Sediment Diffusion in Primary Shallow Rectangular Clarifiers,
W87-09376 5F

Laboratory and Instream Nitrification Rates for Selected Streams,
W87-09378 2H

Scanning Currents in Stokes Flow and the Efficient Feeding of Small Organisms,
W87-09385 2H

Spectral Analysis of Columbia River Estuary Currents,
W87-09430 2L

Hydraulic Model Study of Port Huron Ice Control Structure,
W87-09473 2C

Erosion Control of Scour During Construction; Report 6: FINITE - A Numerical Model for Combined Refraction and Diffraction of Waves,
W87-09482 8B

Low Freshwater Inflow Study: Chesapeake Bay Hydraulic Model Investigation,
W87-09484 2L

Kahului Breakwater Stability Study, Kahului, Maui, Hawaii: Hydraulic Model Investigation,
W87-09488 8B

Influence of Underground Engineering Works on Hydrogeological Conditions of the Suburban Areas,
W87-09581 2F

MODEL TESTING

Transformation of Input to a Stochastic Model Using a Distribution Deterministic Model,
W87-08825 2E

Correlation of a Lake Eutrophication Model to Field Experiments,
W87-08900 2H

MODELS

Estimating Evapotranspiration,
W87-09469 2D

Simulation Model for Predicting Effect of Water Stress on Yield: An Example Using Corn,
W87-09470 3F

Fixed-Cone Valve Prototype Tests, Final Series, New Melones Dam, California,
W87-09483 8C

MOHAWK CANAL

Preventing Desert Mule Deer Drownings in the Mohawk Canal, Arizona,
W87-09152 6G

MOISTURE STRESS

Model for Predicting the Influence of Moisture Stress on Crop Losses Caused by Ozone,
W87-08783 2I

MOISTURE TENSION

Variation of the Subsoil Hydraulic Conductivities of Some New Zealand Soils with Changes in Water Tension,
W87-08736 2G

MOLECULAR STRUCTURE

Molecular Size and Weight Measurements of Humic Substances,
W87-09085 7B

MOLLUSKS

Use of Asiatic Clam Larvae in Aquatic Hazard Evaluations,
W87-09326 5C

MOLYBDENUM

Epidemiology of Dental Caries in Relation to Environmental Trace Elements,
W87-08694 5C

MONITORING

What Industry is Doing to Protect Aquatic Life,
W87-08628 5G

Research Needs for Rapid Assessments of Chronic Toxicity,
W87-08630 5C

Monitoring Well Installation, Purging, and Sampling Techniques - Part 1: Conceptualizations,
W87-08755 7B

Trees as Indicators of Subterranean Water Flow from a Retired Radioactive Waste Disposal Site,
W87-08845 5A

Use of the Pocketbook Mussel, Lampsilis ventricosa, for Monitoring Heavy Metal Pollution in an Ozark Stream,
W87-08875 5A

Cadmium Contamination in American Lobster, Homarus americanus, Near a Coastal Lead Smelter: Use of Multiple Linear Regression for Management,
W87-08882 5C

Metal-Binding Protein in the Pacific Oyster, Crassostrea gigas: Assessment of the Protein as a Biochemical Environmental Indicator,
W87-08885 5A

Two New Ground-Level Cloud Water Sampler Designs Which Reduce Rain Contamination,
W87-08948 7B

Groundwater-Leachate: Modeling/Monitoring/Sampling,
W87-09089 5B

Data Collection and Instrumentation,
W87-09103 7B

Improved Monitoring Techniques to Assess Groundwater Quality Near Sources of Contamination,
W87-09126 5A

Effluent Evaluation,
W87-09302 5A

Instrumentation for Environmental Monitoring, Volume 2: Water,
W87-09303 5A

On-Site Observations of the State of Structures at the Kanev Lock,
W87-09363 7A

Monitoring Programme for Embankment Dams,
W87-09409 8A

Surveillance, Tracking, and Model Correlation of the Spill from the Tanker Burmah Agate,
W87-09520 7B

MONITORING WELLS

Monitoring Well Installation, Purging, and Sampling Techniques - Part 1: Conceptualizations,
W87-08755 7B

MONSOONS

Water Vapor Transport Over the Indian Ocean During the 1979 Summer Monsoon. Part I: Water Vapor Fluxes,
W87-08937 2B

Empirical Prediction of the Summer Monsoon Rainfall over India,
W87-08940 2B

MONTANA

Cultural Resource Inventory of Fresno Reservoir, Hill County, Montana,
W87-09331 6G

Limnological Investigations: Lake Koocanusa, Montana; Part 3: Basic Data, Post-Impoundment, 1972-1978,
W87-09463 2H

MONTE CARLO METHOD
Generalized Method of Moments as Applied to Problems of Flood Frequency Analysis: Some Practical Results for the Log-Pearson Type 3 Distribution,
W87-08616 2E

MORAINE
Estimation of Groundwater Recharge in Sandy Till with Two Different Methods Using Groundwater Level Fluctuations,
W87-08615 2F

MORPHOLOGY
Responses of Gas Exchange to Humidity in Populations of Three Herbs from Environments Differing in Atmospheric Water,
W87-09346 2I

MOSQUITOES
Prediction of the Occurrence of Four Species of Mosquito Larvae with Logistic Regression on Water-Chemistry Variables,
W87-08846 2H

Effect of Mosquito Killer Insecticides on Freshwater Mussels,
W87-08908 5C

MOSSES
Glutathione Status and Protein Synthesis During Drought and Subsequent Rehydration in Tortula ruralis,
W87-09417 2I

MUD FLATS
Hydrodynamics and Structure: Interactive Effects on Meiofauna Dispersal,
W87-08838 2L

MUEDA
Water Use and Health in Mueda, Mozambique,
W87-08777 5F

MULLET
Comparative Kinetics for Bioaccumulation of Polychlorinated Biphenyls by the Polychaete (Capitella capitata) and Fish (Mugil cephalus),
W87-08856 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: I. Metabolism in the Euryhaline Fish, Oryzias latipes and Mugil cephalus,
W87-08859 5B

MULTIATTRIBUTE ANALYSIS
Multiattribute Analysis of the Impact on Society of Phosphorus Abatement Measures,
W87-09013 5G

MULTISLOT DIVISORS
Semiportable Multislot Divisor for Erosion and Runoff Measurements,
W87-09010 7B

MULTISPECIES TESTS
Multispecies Tests: Research Needs to Assess the Effects of Chemicals on Aquatic Life,
W87-08632 5A

MULTIVARIATE ANALYSIS
Data Intercomparison Theory II. Trinity Statistics for Location, Spread and Pattern Differences,
W87-09504 7C

Data Intercomparison Theory III. S-Phase and T-Phase Tests for Spatial Pattern and Temporal Evolution,
W87-09505 7C

MUNICIPAL WASTES
Attenuation of Cd and Pb Solubility in Municipal Waste Incinerator Ash,
W87-08776 5E

MUNICIPAL WASTEWATER
Effect of Fertilization with Municipal Sludge on the Glutathione, Polyamine, and Cadmium Content of Cole Crops and Associated Loopers (Trichoplusia ni),
W87-08835 5C

MUNICIPAL WATER
Cooperative Solution for a Water System 'Emergency',
W87-08807 5F

Handbook of Public Water Systems.
W87-09063 5F

MUSKINGUM RIVER
Assessment of Effluent Impacts through Evaluation of Periphyton Diatom Community Structure,
W87-09320 5C

MUSSELS
Use of the Pocketbook Mussel, Lampsilis ventricosa, for Monitoring Heavy Metal Pollution in an Ozark Stream,
W87-08875 5A

Effect of Mosquito Killer Insecticides on Freshwater Mussels,
W87-08908 5C

Effects of Intermittent Exposure to Suspended Solids and Turbulence on Three Species of Freshwater Mussels,
W87-09381 6G

MUTAGENIC ACTIVITY
Absence of Mutagenic and Antimutagenic Activities of Fluoride in Ames Salmonella Assays,
W87-09405 5C

MUTAGENS
Isolation of Mutagenic Components by High-Performance Liquid Chromatography from XAD Extract of Water from the Nishitakase River, Kyoto City, Japan,
W87-08723 5A

Absence of Mutagenic and Antimutagenic Activities of Fluoride in Ames Salmonella Assays,
W87-09405 5C

MYCORRHIZA
Water Relations of Xeric Grasses in the Field: Interactions of Mycorrhizzas and Competition,
W87-09341 2I

MYSIDOPSIS
Effects of Triethylene Glycol on Mysidopsis bahia (Crustacea: Mysidacea) and Menidia peninsulae (Pisces: Atherinidae),
W87-08644 5C

MYTILUS
Seasonality of Blue Mussel, Mytilus edulis L., Larvae in the Damariscotta River Estuary, Maine, 1969-77,
W87-08849 2L

NATURAL WATER
Potential for Transduction of Plasmids in a Natural Freshwater Environment: Effect of Plasmid Donor Concentration and a Natural Microbial Community on Transduction in Pseudomonas aeruginosa,
W87-09390 2H

NATURAL WATERS
Role of Cupric Ions in the Generation of Superoxide in Natural Waters,
W87-08716 2K

Effect of Storage on the Distribution of Trace Elements (Lead, Cadmium, Copper, Zinc and Mercury) in Natural Water,
W87-08914 5A

Evaluation of Natural Tracers in an Acidic and Metal-Rich Stream,
W87-09021 7B

NAVIGATION
On-Site Observations of the State of Structures at the Kanev Lock,
W87-09363 7A

NEUTRALIZATION
Acid Neutralizing Capacity of Fine Soil Fractions,
W87-09180 2G

NEVADA
Study of Saline Water Use at the Harry Allen Generating Station,
W87-09332 3C

NEW MEXICO
History of the Carlsbad Basin, Southeastern New Mexico,
W87-09151 6G

Pecos Past: The Prehistory and History of the Brantley Project Locality,
W87-09155 6G

Prehistory of the Carlsbad Basin, Southeastern New Mexico,
W87-09156 6G

NEW WADDELL DAM
Settlement, Subsistence, and Specialization in the Northern Periphery: Research Design for Mitigative Data Recovery at Sites in the New Waddell Dam Borrow Areas,
W87-09094 6G

NEW YORK
Recent Developments in the Treatment of Drinking Water with Ozone,
W87-09146 5F

Social and Economic Impacts of Selected Potential Dredged Material Containment Facilities in Long Island Sound.
W87-09471 6B

Dredged Material Containment in Long Island Sound (With Special Emphasis on Eastern New York Waters),
W87-09474 8A

NICKEL
Determination of Cobalt, Copper, Mercury, and Nickel as Bis(2-hydroxyethyl)dithiocarbamate Complexes by High-Performance Liquid Chromatography,
W87-08831 5A

Effects of pH and Soil Type on Concentrations of Zinc, Copper and Nickel Extracted by Calcium Chloride from Sewage Sludge-Treated Soils,
W87-08911 5B

NIGERIA
Physical Changes Induced by Rainfall in the Surface Layer of an Alfisol, Northern Nigeria,
W87-09214 2G

NISHITAKASE RIVER
Isolation of Mutagenic Components by High-Performance Liquid Chromatography from XAD Extract of Water from the Nishitakase River, Kyoto City, Japan,
W87-08723 5A

NITRATES
Profiles of Nitrogen Species in a Sand-Silt Aquifer at Haslemoen, Solor, South Norway,
W87-08818 5B

Lead Nitrate Induced Changes in the Thyroid Physiology of the Catfish Clarias batrachus (L),
W87-08850 5C

NITRATES

15N/14N Ratios of Nitrate and Ammonium in Rain at Pretoria, South Africa,
W87-08944 2B

Vacuum Trough Extractors for Measuring Drainage and Nitrate Flux Through Sandy Soils,
W87-08989 7B

Ammonia, Nitrite, and Nitrate,
W87-09294 5C

NITRIFICATION

Laboratory and Instream Nitrification Rates for Selected Streams,
W87-09378 2H

NITRITES

Ammonia, Nitrite, and Nitrate,
W87-09294 5C

NITROGEN

Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulfur, Micronutrients,
W87-08689 2G

Profiles of Nitrogen Species in a Sand-Silt Aquifer at Haslemoen, Solor, South Norway,
W87-08818 5B

Dynamics of Nitrogen and Carbon in Soil during Papermill Sludge Decomposition,
W87-08891 5E

Volatilization Loss of Nitrogen from Submerged Saline Soil,
W87-08892 2G

Biological Denitrification of a Highly Nitrogenous Industrial Effluent: A Case Study in Zimbabwe,
W87-08964 5D

Nature of Nitrogen in Humic Substances,
W87-09078 2H

Removal of Ammonia and Other Nitrogen Derivatives from Drinking Water with Ozone,
W87-09141 5F

Atmospheric Deposition of Nitrogen and Phosphorus in Florida,
W87-09175 5B

Importance of Atmospheric Fluxes to the Nitrogen Balance of Lakes in the Florida Peninsula,
W87-09176 2H

Enhancement of Inorganic Nitrogen and Phosphate Release from Lake Sediment by Tubificid Worms and Chironomid Larvae,
W87-09404 2H

NITROGEN COMPOUNDS

Effect of Fertilization with Municipal Sludge on the Glutathione, Polyamine, and Cadmium Content of Cole Crops and Associated Loopers (Trichoplusia ni),
W87-08835 5C

Fate of Some Components of Acidic Deposition in Ombrotrophic Mires,
W87-09382 5B

NITROGEN CYCLE

Effect of Polluted and Leached Snow Melt Waters on the Soil Bacterial Community--Quantitative Response,
W87-08874 5C

Free Amino Acids in Marine Rains: Evidence for Oxidation and Potential Role in Nitrogen Cycling,
W87-09349 2B

NITROGEN FIXATION

Residual Effects of Sewage Sludge on Soybean: II. Accumulation of Soil and Symbiotically Fixed Nitrogen,
W87-08922 5C

Lake Loading Ratios (N:P) and Lacustrine Nitrogen Fixation,
W87-08972 2H

NITROGEN ISOTOPES

15N/14N Ratios of Nitrate and Ammonium in Rain at Pretoria, South Africa,
W87-08944 2B

NON-POINT SOURCES

Leaching Losses from Irrigated Pasture: Waiau Irrigation Scheme, North Canterbury,
W87-08737 5B

NONPOINT POLLUTION SOURCES

Nonpoint Source Pollution Models for Chemicals,
W87-08673 5B

Acute Toxicity of Emulsifiable Concentrations of Three Insecticides Commonly Found in Nonpoint Source Runoff into Estuarine Waters to the Mummichog, Fundulus heteroclitus,
W87-08881 5C

Nonpoint Agricultural Pollution: Pesticide Contamination of Groundwater Supplies,
W87-09213 5B

NONPOINT SOURCES

Effect of Upland Pasture Improvement on Nutrient Release in Flows from a 'Natural' Lysimeter and a Field Drain,
W87-08741 5G

NOTEMIGONUS

Influence of Cadmium Exposure on Selected Hematological Parameters in Freshwater Teleost, Notemigonus crysoleucas,
W87-08857 5C

NOVA SCOTIA

Effects of an Acidic River, Caused by Acidic Rain, on Weight Gain, Steroidogenesis, and Reproduction in the Atlantic Salmon (Salmo salar),
W87-08651 5C

Effects of Low Ambient pH on Perivitelline Fluid of Ambystoma maculatum (Shaw) Eggs,
W87-08963 5C

NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY

Application of Nuclear Magnetic Resonance Spectroscopy for Determining Functionality in Humic Substances,
W87-09088 7B

NUCLEAR POWER PLANTS

Thermal and Dissolved Oxygen Characteristics of a South Carolina Cooling Reservoir,
W87-08975 2H

NUCLEAR POWERPLANTS

Attempts to Determine the Viability of a Deep Excavation on the Coast of the Vandellos Massif (Tarragona, Spain) (Ensayos Para Determinar la Viabilidad de una Excavacion Profunda en el Litoral del Macizo de Vandellos (Tarragona, Expana)),
W87-09574 2F

NUCLEATION

Numerical Simulation of the Effects of Varying Ice Crystal Nucleation Rates and Aggregation Processes on Orographic Snowfall,
W87-08697 2B

NUMERICAL ANALYSIS

2-D Elastoplastic Seismic Shear Response of Earth Dams: Theory,
W87-08607 8A

2-D Elastoplastic Seismic Shear Response of Earth Dams: Applications,
W87-08608 8A

Numerical Simulation of the Effects of Varying Ice Crystal Nucleation Rates and Aggregation Processes on Orographic Snowfall,
W87-08697 2B

Reverse Pathline Calculation of Time-Related Capture Zones in Nonuniform Flow,
W87-08753 2F

Impact of the Dupuit-Forchheimer Approximation on Salt-Water Intrusion Simulation,
W87-08758 2F

First-Order Reliability Approach to Stochastic Analysis of Subsurface Flow and Contaminant Transport,
W87-09017 5B

Gravity Drainage Analysis for Scale Heterogeneous Porous Materials Under Falling Water Table Conditions,
W87-09020 2G

Turbulence Statistics in Fully Developed Channel Flow at Low Reynolds Number,
W87-09383 8B

Effects of Storage Reallocation on Thermal Characteristics of Cowanesque Lake, Pennsylvania: Numerical Model Investigation,
W87-09485 2H

NUTRIENT BUDGET

Lake Loading Ratios (N:P) and Lacustrine Nitrogen Fixation,
W87-08972 2H

NUTRIENTS

Brood Size and Neonate Weight of Daphnia magna Produced by Nine Diets,
W87-08641 2H

Influence of Soil Water Content on the Supply of Phosphate to Plants,
W87-08705 2I

Effect of Upland Pasture Improvement on Nutrient Release in Flows from a 'Natural' Lysimeter and a Field Drain,
W87-08741 5G

Lake Effect on Stream Living Brown Trout (Salmo trutta),
W87-08763 2H

Regulation of Submerged Aquatic Plant Distribution in a Uniform Area of a Weedbed,
W87-08836 2H

Volatilization Loss of Nitrogen from Submerged Saline Soil,
W87-08892 2G

Trace and Nutrient Element Transfer from Sewage Sludge-Amended Soil to Crops: A Study on Brassica oleracea,
W87-08917 5B

Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: I. Persistence, Yield, Quality, and Elemental Removal,
W87-08919 5C

Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: II. Rainfall Runoff and Soil Chemical Properties,
W87-08920 5C

Algal Phagotrophy: Regulating Factors and Importance Relative to Photosynthesis in Dinobryon (Chrysophyceae),
W87-08929 2H

Effects of Cd(2+) and EDTA on Young Sugar Beets (Beta vulgaris). II. Net Uptake and Distri-

bution of Mg(2+), Ca(2+), and Fe(2+)/Fe(3+),
W87-09228 2I

Mineral Content of Grasses and Grasslands of the Himalayan Region: 2. Concentration of Trace and Major Elements in Grasses in Relation to Soil Properties and Climatic Factors,
W87-09256 2I

Effect of Beaver Ponds on the Nonpoint Source Water Quality of a Stream in Southwestern Wyoming,
W87-09265 2H

Water Relations of Xeric Grasses in the Field: Interactions of Mycorrhizzas and Competition,
W87-09341 2I

Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XIII. The Effect of Fe(2+) on Photosynthesis and Respiration of Salix caprea and S. cinerea ssp. oleifolia,
W87-09400 2I

OAK RIVER

Ameliorative Methods to Reinstate Fisheries Following Land Drainage Operations,
W87-09048 6G

OAK TREES

Impact of Irrigation and Experimental Drought Stress on Leaf-Mining Insects of Emory Oak,
W87-09402 2I

OCEAN DUMPING

Social and Economic Impacts of Selected Potential Dredged Material Containment Facilities in Long Island Sound.
W87-09471 6B

Dredged Material Containment in Long Island Sound (With Special Emphasis on Eastern New York Waters),
W87-09474 8A

OCEANOGRAPHY

Focus: Fisheries Oceanography Cooperative Users System,
W87-09500 7C

ODOR CONTROL

Control of Tastes and Odors in Drinking Water with Ozone,
W87-09137 5F

OGEECHEE RIVER

Geochemistry of Stream Fulvic and Humic Substances,
W87-09073 2H

OHIO

Assessment of Effluent Impacts through Evaluation of Periphyton Diatom Community Structure,
W87-09320 5C

OHIO RIVER

Effects of Exposure Time, Season, Substrate Type, and Planktonic Populations on the Taxonomic Composition of Algal Periphyton on Artificial Substrates in the Ohio and Little Miami Rivers, Ohio,
W87-09321 5C

OIL

Laboratory Determination of Dispersant Effectiveness: Method Development and Results,
W87-09509 5G

OIL POLLUTION

Growth and Development of Rana arvalis in Conditions Imitating Oil Contamination,
W87-08713 5C

Toxicity of Chemically Dispersed Oil to Shrimp Exposed to Constant and Decreasing Concentrations in a Flowing System,
W87-09516 5C

Effects of Dimethylnaphthalene and Fluctuating Temperatures on Estuarine Shrimp,
W87-09517 5C

Geomorphological Alteration of a Heavily Oiled Saltmarsh (Ile Grande, France) as a Result of Massive Cleanup,
W87-09543 5B

Fate of the Zoe Colocotroni Oil Spill and its Effects on Infaunal Communities Associated with Mangroves,
W87-09544 5C

Ten Years of Saltmarsh Monitoring - The Case History of a Southampton Water Saltmarsh and a Changing Refinery Effluent Discharge,
W87-09545 5C

Restoration of Oiled Marshes Through Sediment Stripping and Spartina Propagation,
W87-09546 5G

Contamination of Groundwater by Hydrocarbons from a Refinery - A Case History,
W87-09547 5G

Comprehensive Model for Oil Spill Simulation,
W87-09552 5B

Effects of Oil Spills on Mangrove Forests: A Comparison of Five Oil Spill Sites in the Gulf of Mexico and the Caribbean Sea,
W87-09558 5C

Effect of Crude Oil on Microbial Processes in Marine Sediments,
W87-09567 5C

OIL POLLUTION CONTROL

Effectiveness of Offshore Produced Water Treatment,
W87-09515 5D

OIL POLLUTION EFFECTS

Polycyclic Aromatic Hydrocarbons in Oysters (Crassostrea Virginica) from Georgia Coastal Waters, Analyzed by High-Pressure Liquid Chromatography,
W87-09542 5A

OIL RECOVERY

Onshore Impacts and Cleanup During the Burmah Agate Oil Spill - November 1979,
W87-09518 5C

Burmah Agate - Chronology and Containment Operations,
W87-09519 5B

Dome's Petroleum Study of Oil and Gas Under Sea Ice,
W87-09525 5G

Containment of Oil Spilled Under Rough Ice,
W87-09526 5B

Kurdistan - An Unusual Spill Successfully Handled,
W87-09527 5G

Contamination of Groundwater by Hydrocarbons from a Refinery - A Case History,
W87-09547 5G

Development and Testing of a Weir Boom for Oil Recovery at Sea,
W87-09563 5G

Experiences Gained From Deployment of Booms and Skimmers in Various Oil Recovery Applications,
W87-09564 5G

Design Aspects of the First 'Slicktrail' Dredger, The Cosmos,
W87-09566 5G

OIL SKIMMERS

Burmah Agate - Chronology and Containment Operations,
W87-09519 5B

Meredosia Oil Terminal - The Illinois River Floods a Tank Farm,
W87-09531 5G

Flow Around Spill Cleanup Devices,
W87-09561 5G

Open Ocean Skimmer Performance Tests,
W87-09562 5G

OIL SLICKS

Surveillance, Tracking, and Model Correlation of the Spill from the Tanker Burmah Agate,
W87-09520 7B

Simplified Models to Predict the Breakup of Oil on Rough Seas,
W87-09521 5B

Spreading, Dispersion, and Evaporation of Oil Slicks in the Arabian Gulf,
W87-09522 5B

Oil Slick Igniter for remote Areas,
W87-09559 5G

OIL SPILLS

Feeding Reduction and Recovery in Cunner Tautogolabrus adspersus Following Exposure to Crude Oil,
W87-09239 5C

Response of Marine Animals to Petroleum and Specific Petroleum Hydrocarbons,
W87-09308 5C

Petroleum Spills in the Marine Environment: The Chemistry and Formation of Water-in-Oil Emulsions and Tar Balls,
W87-09339 5B

Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup).
W87-09507 5B

Evaluation of Oil Spill Dispersant Testing Requirements,
W87-09508 5G

Laboratory Determination of Dispersant Effectiveness: Method Development and Results,
W87-09509 5G

View of the Laboratory Testing and Assessment of Oil Spill Dispersant Efficiency,
W87-09510 5G

Use of Dispersants on Viscous Fuel Oils and Water in Crude Oil Emulsions,
W87-09511 5G

Biodegration of Chemically Dispersed Crude Oil,
W87-09512 5B

Toxicity of Chemically Dispersed Oil to Shrimp Exposed to Constant and Decreasing Concentrations in a Flowing System,
W87-09516 5C

Effects of Dimethylnaphthalene and Fluctuating Temperatures on Estuarine Shrimp,
W87-09517 5C

Onshore Impacts and Cleanup During the Burmah Agate Oil Spill - November 1979,
W87-09518 5C

Burmah Agate - Chronology and Containment Operations,
W87-09519 5B

Surveillance, Tracking, and Model Correlation of the Spill from the Tanker Burmah Agate,
W87-09520 7B

Simplified Models to Predict the Breakup of Oil on Rough Seas,
W87-09521 5B

Spreading, Dispersion, and Evaporation of Oil Slicks in the Arabian Gulf,
W87-09522 5B

BIOS Project - Frontier Oil Spill Countermeasures Research,
W87-09523 5G

Dome Petroleum's Oil Spill Research and Development Program for the Arctic,
W87-09524 5G

Dome's Petroleum Study of Oil and Gas Under Sea Ice,
W87-09525 5G

Containment of Oil Spilled Under Rough Ice,
W87-09526 5B

Kurdistan - An Unusual Spill Successfully Handled,
W87-09527 5G

Wreck of the Lee Wang Zin,
W87-09528 5G

Cold Weather Response F/V Ryuyo Maru No. 2 St. Paul, Pribiloff Islands, Alaska,
W87-09529 5G

Coast Guard Environmental Mission Fulfilled by Naval Salvage, French Frigate Shoals,
W87-09530 5G

Meredosia Oil Terminal - The Illinois River Floods a Tank Farm,
W87-09531 5G

Unique Inland Oil Spill - Glenrock, Wyoming,
W87-09532 5G

Assessment of Aerial Application of Oil Spill Dispersants,
W87-09533 5G

Aerial Application of Dispersants at the Ixtoc I Spill,
W87-09534 5G

Oil Spill Cleanup with Dispersants: A Boomed Oil Spill Experiment,
W87-09535 5G

1979 Southern California Dispersant Treated Research Oil Spills,
W87-09536 5G

Fate and Effects of Dispersant-Treated Compared with Untreated Crude Oil, with Particular Reference to Sheltered Intertidal Sediments,
W87-09537 5G

Spill Impacts and Shoreline Cleanup Operations on Arctic and Sub-Arctic Coasts,
W87-09538 5G

Coastal Ecosystem Studies and Their Application to Oil Spill Response,
W87-09539 5C

Mapping the Distribution of Protected and Valuable, Oil-Sensitive Coastal Fish and Wildlife,
W87-09540 7A

Impact of Oil on Marsh Communities in the St. Lawrence River,
W87-09541 5C

Polycyclic Aromatic Hydrocarbons in Oysters (Crassostrea Virginica) from Georgia Coastal Waters, Analyzed by High-Pressure Liquid Chromatography,
W87-09542 5A

Geomorphological Alteration of a Heavily Oiled Saltmarsh (Ile Grande, France) as a Result of Massive Cleanup,
W87-09543 5B

Fate of the Zoe Colocotroni Oil Spill and its Effects on Infaunal Communities Associated with Mangroves,
W87-09544 5C

Restoration of Oiled Marshes Through Sediment Stripping and Spartina Propagation,
W87-09546 5G

Effects of Oil Spill Cleanup Techniques on a Salt Marsh,
W87-09548 5C

Response to the Esso Bayway Oil Spill,
W87-09549 5G

Impact of the Esso Bayway Oil Spill on Salt Marsh Macro Fauna,
W87-09550 5C

Impacts of a Spill of No. 6 Fuel Oil on Lake Winona,
W87-09551 5C

Comprehensive Model for Oil Spill Simulation,
W87-09552 5B

Atlantic Empress Sinking - A Large Spill Without Environmental Disaster,
W87-09553 5C

Ixtoc I Oil Spill - The Damage Assessment Program and Ecological Impact,
W87-09554 5C

Effects of the Ixtoc I Oil Spill on Texas Shorebird Populations,
W87-09555 5C

Effects of the Ixtoc I Oil Spill on the Intertidal and Subtidal Infaunal Populations Along Lower Texas Coast Barrier Island Beaches,
W87-09556 5C

Impact and Persistence of Ixtoc I Oil on the South Texas Coast,
W87-09557 5C

Effects of Oil Spills on Mangrove Forests: A Comparison of Five Oil Spill Sites in the Gulf of Mexico and the Caribbean Sea,
W87-09558 5C

Oil Slick Igniter for remote Areas,
W87-09559 5G

Development of a Flaring Burner Oil Disposal System,
W87-09560 5D

Flow Around Spill Cleanup Devices,
W87-09561 5G

Open Ocean Skimmer Performance Tests,
W87-09562 5G

Development and Testing of a Weir Boom for Oil Recovery at Sea,
W87-09563 5G

Experiences Gained From Deployment of Booms and Skimmers in Various Oil Recovery Applications,
W87-09564 5G

Coherent, Plunging Water Jets for Oil Spill Control,
W87-09565 5G

Design Aspects of the First 'Slicktrail' Dredger, The Cosmos,
W87-09566 5G

Effect of Crude Oil on Microbial Processes in Marine Sediments,
W87-09567 5C

OIL WELLS

Processes Affecting the Distribution of Low-Molecular-Weight Aliphatic Hydrocarbons in Cook Inlet, Alaska,
W87-09506 5B

OILS

Toxicity of Aqueous Extracts of Natural and Synthetic Oils to Three Species of Lemna,
W87-08647 5C

OILY WATER

Distribution of Aromatic Hydrocarbons in Port Valdez, Alaska,
W87-09513 5B

Toxicity of Ballast-Water Treatment Effluent to Marine Organisms at Port Valdez, Alaska,
W87-09514 5C

Kurdistan - An Unusual Spill Successfully Handled,
W87-09527 5G

OKLAHOMA

Report on Additional Human Skeletal Material Exposed by Reservoir Induced Erosion at Lake Altus, Southwestern Oklahoma,
W87-09161 6G

OKRA

Responses of Leaf Water Potential and Leaf Diffusive Resistance to Abscisic Acid, Water Stress and Low Temperature in Hibiscus esculentus: The Effect of Water Stress and ABA Pre-Treatments,
W87-09210 2D

OLIGOTROPHIC BACTERIA

Movement of Oligotrophic Bacteria in Activated Sludge,
W87-08771 5D

OLIGOTROPHIC LAKES

Ecological Modelling of a High Mountain Reservoir in Relation to Particulate Organic Matter Loading,
W87-08786 2H

OMAHA

Omaha Recycles Sludge in Agricultural Program,
W87-08808 5E

ON-SITE DATA COLLECTIONS

Examination of Tidal Flats, Vol. 3: Evaluation Methodology.
W87-09493 4C

ON-SITE TESTS

Pumping Performance and Turbidity Generation of Model 600/100 Pneuma Pump: Main Text and Appendixes A and B,
W87-09487 8C

ONION SKINS

Separation of Mercury from Aqueous Mercuric Chloride Solutions by Onion Skins,
W87-08606 5D

ONTARIO

Analysis of the Impact of the Sudbury Smelters on Wet and Dry Deposition in Ontario,
W87-08942 5B

Use of Bog Vegetation as a Monitor of Atmospheric Input of Metals,
W87-09182 5C

OPEN-CHANNEL FLOW
Fluvial Hydrology,
W87-08685 2A

Open-Channel Hydraulics,
W87-08688 8B

BASIC Hydraulics,
W87-09304 8B

OPEN CHANNELS
Open-Channel Hydraulics,
W87-08688 8B

OPERATING COSTS
Puerto Rico Seeks Clean Water,
W87-08802 5D

OPTICAL PROPERTIES
Effect of 'Whiting' on Optical Properties and Turbidity in Owasco Lake, New York,
W87-08966 2H

OPTIMIZATION
Optimization of Closure Operations in a Tidal Basin During a Storm-Surge,
W87-08610 4A

Optimal Water Treatment Plant Design,
W87-09374 5F

ORGANIC CARBON
Atmospheric Deposition of Particulate Organic Carbon and Polyaromatic Hydrocarbons to Lake Michigan,
W87-09187 5B

ORGANIC COMPOUNDS
Recovery of Organics from Tailings Pond Sludge Using Coke for Agglomeration,
W87-08602 5D

Electrochemical Analysis of Organic Pollutants,
W87-08612 5A

Biodegradation,
W87-08680 5B

In Vitro Cytotoxicity of Organic Pollutants to Bluegill Sunfish (BF-2) Cells,
W87-08843 5C

Limits of Bioaccumulation of Organic Pigments in Fish: Their Relation to the Partition Coefficient and the Solubility in Water and Octanol,
W87-08853 5B

Systematic Approach to Adsorption on XAD-2 Resin for the Concentration and Analysis of Trace Organics in Water Below the (mu)g/l Level,
W87-09011 5A

Chemicals and Safe Drinking Water: National and International Perspective,
W87-09115 5C

Occurence of Contamination In Drinking Water From Groundwater Sources,
W87-09125 5B

NBS Environmental Standard Reference Materials for Use in Validating Water Analysis,
W87-09127 5A

Correlation of Some Organic Pollution Factors in Water Systems in Northern Greece,
W87-09264 5B

Prediction of Fixed-Bed Adsorber Removal of Organics in Unknown Mixtures,
W87-09369 5D

ORGANIC LOADING
Ecological Modelling of a High Mountain Reservoir in Relation to Particulate Organic Matter Loading,
W87-08786 2H

ORGANIC MATTER
Pattern of Organic Matter Production by Natural Phytoplankton Population in a Eutrophic Lake 1. Intracellular Products,
W87-08767 2H

Regulation of Submerged Aquatic Plant Distribution in a Uniform Area of a Weedbed,
W87-08836 2H

Organic Matter and Heavy Metal Concentrations in the Particulate Phase of Lake Michigan Surface Microlayers,
W87-09171 5B

ORGANIC SOLVENTS
Spectrophotometric Determination of Traces of Silicon in Water after Collection as Silicomolybdenum Blue on an Organic-Solvent-Soluble Membrane Filter,
W87-08833 5A

Toxic Effects of Organic Solvents on the Growth of Blue-Green Algae,
W87-09236 5C

ORGANIC WASTES
Growth of Mixed Microbial Populations in Ground Water Containing Highly Chlorinated Organic Wastes,
W87-08878 5B

ORGANOCHLORINE COMPOUNDS
Residues of Organochlorine Chemicals and Concentrations of Heavy Metals in Ciconiforme Eggs in Relation to Diet and Habitat,
W87-08916 5B

Aerial Deposition of Organochlorines in Urban and Coastal South Carolina,
W87-09188 5B

Attempt to Measure the Flow of Chlorinated Hydrocarbons, such as PCBs, from Water to Air in the Field,
W87-09246 7B

Gas-Chromatographic Determination of Total Polychlorinated Aromates and Chloro-Paraffins Following Catalytic Reduction in the Injection Port,
W87-09260 5A

ORINOCO RIVER
Selenium in the Tributaries of the Orinoco in Venezuela,
W87-09406 2K

ORNL MODEL
Predictive Application of an ORNL Geohydrology Model,
W87-08760 7C

OROGRAPHIC PRECIPITATION
Numerical Simulation of the Effects of Varying Ice Crystal Nucleation Rates and Aggregation Processes on Orographic Snowfall,
W87-08697 2B

OSCILLATORY WAVES
Surface Manifestations of Internal Oscillations in a Highly Saline Lake (the Dead Sea),
W87-08866 2H

OULUJOKI RIVER
Dredging of Rapids for Timber-Floating in Finland and Its Effects on River-Spawning Fish Stocks,
W87-09045 6G

Food of Whitefish (Coregonus lavaretus) in Two Neighbouring Lakes, One Regulated and the Other Natural,
W87-09055 2H

OUTFALL
Internal Hydraulics of Diffusers with Uniform Lateral Momentum Distribution,
W87-09365 8B

OVERLAND FLOW
Laboratory Experiment on the Role of Grass for Infiltration and Runoff Processes,
W87-08622 2A

Steady-State Analysis of Infiltration and Overland Flow for Spatially-Varied Hillslopes,
W87-08974 2E

OWASCO LAKE
Effect of 'Whiting' on Optical Properties and Turbidity in Owasco Lake, New York,
W87-08966 2H

OXIDATION
Interrelationships of Algae and Bacteria During Methane Oxidation,
W87-08712 2H

SO2 Oxidation in Cloud Drops Containing NaCl or Sea Salt as Condensation Nuclei,
W87-08950 6E

Kinetics and Mechanisms of Hypochlorite Oxidation of alpha-Amino Acids at the Time of Water Disinfection (Cinetiques et Mechanismes de l'Action Oxydative de l'Hypochlorite sur les Acides alpha-Amines lors de la Desinfection des Eaux),
W87-09274 5F

Free Amino Acids in Marine Rains: Evidence for Oxidation and Potential Role in Nitrogen Cycling,
W87-09349 2B

OXIDATION PONDS
Seasonal Distribution of Legionellae Isolated from Various Types of Water in Israel,
W87-08903 5A

OXYGEN
Photosynthesis and Light Adaptation in Epiphyte-Macrophyte Associations Measured by Oxygen Microelectrodes,
W87-08935 7B

OXYGEN BALANCE
Role of Gas Exchange in the Inorganic Carbon, Oxygen, and 222Rn Budgets of the Amazon River,
W87-08871 2H

OXYGEN ISOTOPES
Modelling Water Exchange and Transit Times in Till Basins Using Oxygen-18,
W87-08821 2A

OXYGEN TRANSFER
Geometric Parameters and Efficiency of Diffused Air Systems,
W87-09437 5D

Significance of Oxygen Transfer Variables in the Sizing of Dome Diffuser Aeration Equipment,
W87-09438 5D

Optimization of Mechanical Aerators in a Hydraulic Two-Phase Flow Model and the Scale-Up of the Results for the Prototype,
W87-09439 5D

OXYGENATION
Investigation and Discussion of Techniques for Hypolimnion Aeration/Oxygenation,
W87-09481 5G

OYSTERS
Interlaboratory Comparison of the ASTM Bioconcentration Test Method Using the Eastern Oyster,
W87-08645 5A

Seasonal Variation of Copper and Zinc Concentrations in the Oyster Saccostrea cucullata from the Dampier Archipelago, Western Australia: Implications for Pollution Monitoring,
W87-08732 5B

Metal-Binding Protein in the Pacific Oyster, Crassostrea gigas: Assessment of the Protein as a Biochemical Environmental Indicator,
W87-08885 5A

Polycyclic Aromatic Hydrocarbons in Oysters (Crassostrea Virginica) from Georgia Coastal Waters, Analyzed by High-Pressure Liquid Chromatography,
W87-09542 5A

OZONATION

Ozone for Drinking Water Treatment - Evolution and Present Status,
W87-09124 5F

Handbook of Ozone Technology and Applications Volume II: Ozone for Drinking Water Treatment.
W87-09134 5F

Ozone Disinfection of Drinking Water,
W87-09135 5F

Removal of Iron and Manganese by Ozone during Drinking Water Treatment in Dusseldorf,
W87-09136 5F

Control of Tastes and Odors in Drinking Water with Ozone,
W87-09137 5F

Removal of Color from Drinking Water with Ozone,
W87-09138 5F

Removal of Detergents from Drinking Water with Ozone,
W87-09139 5F

Removal of Pesticides from Drinking Water with Ozone,
W87-09140 5F

Removal of Ammonia and Other Nitrogen Derivatives from Drinking Water with Ozone,
W87-09141 5F

Biological Drinking Water Treatment Systems Involving Ozone,
W87-09144 5F

Raw Water Preozonation,
W87-09145 5F

Recent Developments in the Treatment of Drinking Water with Ozone,
W87-09146 5F

Ozone for Drinking Water Treatment: A Bibliography,
W87-09147 5F

Unique Pre-Ozonation - D.E. Filtration Water Treatment Plant Design is Based on Pilot Plant Data,
W87-09443 5F

OZONE

Model for Predicting the Influence of Moisture Stress on Crop Losses Caused by Ozone,
W87-08783 2I

Ozone for Drinking Water Treatment - Evolution and Present Status,
W87-09124 5F

Microflocculation by Ozone,
W87-09142 5F

Closed-Loop System for Generating Ozone from Oxygen and Its Application to the Treatment of Drinking Water at Duisburg, Federal Republic of Germany,
W87-09143 5F

Recent Developments in the Treatment of Drinking Water with Ozone,
W87-09146 5F

Ozone for Drinking Water Treatment: A Bibliography,
W87-09147 5F

PACIFIC NORTHWEST

Point Probability Distributions of Frozen Soil,
W87-08696 2C

PACIFIC OCEAN

Relationship of Low-Level Winds and Moisture to Convection in the Tropical Pacific,
W87-08941 2B

PACKED COLUMNS

Biofilm Shearing Under Dynamic Conditions,
W87-09367 5D

PALEOHYDROLOGY

Macrofossil and Pollen Representation of Coniferous Trees In Modern Sediments from Washington,
W87-08690 2H

PANDALUS DANAE

Toxicity of Chemically Dispersed Oil to Shrimp Exposed to Constant and Decreasing Concentrations in a Flowing System,
W87-09516 5C

PARAIBA DO SUL RIVER

Heavy Metal Pollution in the Paraiba do Sul River, Brazil,
W87-08718 5B

PARAQUAT

Lethal Effects of Diquat and Paraquat on Developing Frog Embryos and 15-Day-Old Tadpoles, Rana pipiens,
W87-09235 5C

PARASITES

Comparison of Parasite Fauna of Juvenile Sockeye Salmon (Oncorhynchus Nerka) from Southern British Columbian and Washington State Lakes,
W87-08792 2H

PARIS

Recent Developments in the Treatment of Drinking Water with Ozone,
W87-09146 5F

PARTICLE EXCHANGE

Exchange of Particles and Gases Across Water Surfaces,
W87-09168 5B

PARTICULATE MATTER

Composition of Suspended Particulate Matter from Scottish Coastal Waters Geochemical Implications for the Transport of Trace Metal Contaminants,
W87-08729 5B

Carbon Isotope Fractionation and Changes in the Flux and Composition of Particulate Matter Resulting from Biological Activity during a Sediment Trap Experiment in Lake Greifen, Switzerland,
W87-08867 2H

Vertical Transport of Heavy Metals by Settling Particles in Lake Zurich,
W87-08869 5B

Organic Matter and Heavy Metal Concentrations in the Particulate Phase of Lake Michigan Surface Microlayers,
W87-09171 5B

Characterization of the PAC Profile in Settling Particulates from the Urban Waters of Stockholm,
W87-09237 5B

Distribution of Particulate Matter in Relation to the Thermal Cycle in Lake Vechten (The Netherlands): The Significance of Transportation Along the Bottom,
W87-09275 2H

PASTURE MANAGEMENT

Pasture and Forest Management in the Mediterranean Uplands,
W87-08665 3F

Perennial Pasture Production after Irrigation with Saline Groundwater in the Goulburn Valley, Victoria,
W87-09208 3C

PASTURES

Effect of Soil Slip Erosion on Wairoa Hill Pasture Production and Composition,
W87-08734 2J

Effect of Upland Pasture Improvement on Nutrient Release in Flows from a 'Natural' Lysimeter and a Field Drain,
W87-08741 5G

PATELLA

Statistical Assessment of a Sampling Pattern for Evaluation of Changes in Mercury and Zinc Concentrations in Patella coerulea,
W87-08884 5A

PATH OF POLLUTANT

Modeling of Atmospheric Wet Deposition,
W87-09165 5B

PATH OF POLLUTANTS

Aquatic Hazard Assessment: Picloram,
W87-08643 5C

Usefulness of the Lipid Index for Bioaccumulation Studies with Daphnia magna,
W87-08652 5C

Physical/Chemical Properties of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin,
W87-08657 5B

Environmental Mobility of Dioxins,
W87-08658 5B

Bioconcentration of Four Chlorinated Dioxins by Rainbow Trout and Fathead Minnows,
W87-08659 5B

Model for Estimating the Loading Rate of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin to the Great Lakes,
W87-08660 5B

Environmental Exposure from Chemicals.
W87-08670 5B

Environmental Systems Analysis: An Overview,
W87-08671 5B

Modeling Chemical Transport in Lakes, Rivers, and Estuarine Systems,
W87-08672 5B

Environmental Exposure from Chemicals.
W87-08675 5B

Estimation of Physical Properties,
W87-08676 5B

Air/Soil Exchange Coefficients,
W87-08678 5B

Air/Water Exchange Coefficients,
W87-08679 5B

Photochemical Transformations,
W87-08682 5B

Equilibrium Models for the Initial Integration of Physical and Chemical Properties,
W87-08683 5B

Impact of Mesoscale Convective Systems on Regional Visibility and Oxidant Distributions during Persistent Elevated Pollution Episodes,
W87-08695 2B

Tracer Study of Vertical Exchange by Cumulus Clouds,
W87-08699 2A

90Sr and 137Cs in Peat Deposits of Low-Lying Bog in the Influence Zone of the Beloyarsk Atomic Power Station,
W87-08710 5B

Geochemical Partitioning of Heavy Metals in Sediments of Three Estuaries Along the Coast of Rio de Janeiro (Brazil),
W87-08717 2L

Heavy Metal Pollution in the Paraiba do Sul River, Brazil,
W87-08718 5B

Chlorinated Insecticides and PCBs in Asteroidea and Holothuroidea Species from Rijeka Bay, Yugoslavia,
W87-08724 5B

Mercury Pollution in Marine Sediment Cores Near Cinnabar Deposits and a Chlor-Alkali Plant,
W87-08727 5B

Composition of Suspended Particulate Matter from Scottish Coastal Waters Geochemical Implications for the Transport of Trace Metal Contaminants,
W87-08729 5B

Transport of Arsenic and Mercury from Gold Mining Activities Through an Aquatic System,
W87-08731 5B

Seasonal Variation of Copper and Zinc Concentrations in the Oyster Saccostrea cuccullata from the Dampier Archipelago, Western Australia: Implications for Pollution Monitoring,
W87-08732 5B

Use of Bullfrogs (Rana catesbeiana) as Biological Markers for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin Contamination in the Environment,
W87-08733 5A

Leaching Losses from Irrigated Pasture: Waiau Irrigation Scheme, North Canterbury,
W87-08737 5B

Distribution Coefficient of Trichloroethylene in Soil-Water Systems,
W87-08752 5B

Comparison of Field and Laboratory Methods for Determining Contaminant Flow Parameters,
W87-08757 5B

Performance and Analysis of Aquifer Tracer Tests with Implications for Contaminant Transport Modeling - A Project Summary,
W87-08759 5B

Managing Powerplant Combustion Wastes,
W87-08803 5E

Profiles of Nitrogen Species in a Sand-Silt Aquifer at Haslemoen, Solor, South Norway,
W87-08818 5B

Laboratory Experiments on Solute Transport in Non-Homogeneous Porous Media,
W87-08819 5B

Stochastic Modelling of a Contaminated Aquifer: The Unconditional Approach,
W87-08820 5B

Heavy Metal Pollution of the Mid-Canal of Kandy: An Environmental Case Study from Sri Lanka,
W87-08840 5C

Effect of Ingested Benzo(a)pyrene and Cadmium on Tissue Accumulation, Hydroxylase Activity, and Intestinal Morphology of the Black Sea Bass, Centropristis striata,
W87-08842 5C

Age-Dependent Lung Doses from Ingested 222Rn in Drinking Water,
W87-08844 5C

Trees as Indicators of Subterranean Water Flow from a Retired Radioactive Waste Disposal Site,
W87-08845 5A

Limits of Bioaccumulation of Organic Pigments in Fish: Their Relation to the Partition Coefficient and the Solubility in Water and Octanol,
W87-08853 5B

Comparative Kinetics for Bioaccumulation of Polychlorinated Biphenyls by the Polychaete (Capitella capitata) and Fish (Mugil cephalus),
W87-08856 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: I. Metabolism in the Euryhaline Fish, Oryzias latipes and Mugil cephalus,
W87-08859 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: II. Metabolism in the Freshwater Snails, Cipangopaludina japonica and Physa acuta,
W87-08860 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: III. Metabolism in the Crustaceans, Daphnia pulex and Palaemon paucidens,
W87-08861 5B

Vertical Transport of Heavy Metals by Settling Particles in Lake Zurich,
W87-08869 5B

Growth of Mixed Microbial Populations in Ground Water Containing Highly Chlorinated Organic Wastes,
W87-08878 5B

Organochlorine Pesticide Residues in Fish from the Shatt al-Arab River, Iraq,
W87-08880 5B

Cadmium and Lead in Lake Ontario Salmonids,
W87-08883 2H

Statistical Assessment of a Sampling Pattern for Evaluation of Changes in Mercury and Zinc Concentrations in Patella coerulea,
W87-08884 5A

Understanding the Origin of Radon Indoors--Building a Predictive Capability,
W87-08888 5B

Effect of Irrigation on Persistent Toxicity of Insecticides Applied as Granules to Soil to Brown Plant Hopper and Rice Swarming Caterpillar,
W87-08897 5B

Mathematical Model of Seasonal and Spatial Variation in Phosphorus Concentrations in Lake Memphremagog, Quebec,
W87-08899 5B

Epidemiological Evidence of Legionellosis Transmission through Domestic Hot Water Supply Systems and Possibilities of Control,
W87-08905 5F

Exposure to Legionella in Geriatric Institutions,
W87-08907 5B

Contamination of Fish from the French Zone of Lake Leman by Organochlorine Compounds between 1973 and 1981 (Contamination des Poissons du Secteur Francais du Lac Leman, par les Composes Organochlores entre 1973 et 1981),
W87-08909 2H

Residues of Organochlorine Pesticides in Environmental Samples from the Shatt-al-Arab River, Iraq,
W87-08910 5B

Effects of pH and Soil Type on Concentrations of Zinc, Copper and Nickel Extracted by Calcium Chloride from Sewage Sludge-Treated Soils,
W87-08911 5B

Asbestos Fibres Introduce Trace Metals into Streamwater and Sediments,
W87-08912 5B

Fate of 14C-Lindane in a Rice-Fish Model Ecosystem,
W87-08915 5B

Residues of Organochlorine Chemicals and Concentrations of Heavy Metals in Ciconiforme Eggs in Relation to Diet and Habitat,
W87-08916 5B

Trace and Nutrient Element Transfer from Sewage Sludge-Amended Soil to Crops: A Study on Brassica oleracea,
W87-08917 5B

Residual Effects of Sewage Sludge on Soybean: I. Accumulation of Heavy Metals,
W87-08921 5C

Residual Effects of Sewage Sludge on Soybean: II. Accumulation of Soil and Symbiotically Fixed Nitrogen,
W87-08922 5C

Ammonium Bicarbonate-DTPA and DTPA Extractions of Sludge-Amended Soils,
W87-08923 5A

Mobility of Sludge-Borne 3,3'-Dichlorobenzidine in Soil Columns,
W87-08925 5B

Chemistry of Tension Lysimeter Water and Lateral Flow in Spruce and Hardwood Stands,
W87-08926 5B

Soybean Growth and Boron Distribution in a Sandy Soil Amended with Scrubber Sludge,
W87-08927 5C

Seasonal and Spatial Trends in South Greenland Snow Chemistry,
W87-08946 5B

Scavenging of Atmospheric Sulfate by Arctic Snow,
W87-08947 2C

Velocity Control as a Tool for Optimal Plume Containment in the Equus Beds Aquifer, Kansas,
W87-08982 5G

Vacuum Trough Extractors for Measuring Drainage and Nitrate Flux Through Sandy Soils,
W87-08989 7B

Solute Transport During Absorption and Infiltration: A Comparison of Analytical Approximations,
W87-08990 7C

Elimination of Time Assignment Bias in Estimates of Dispersion Coefficient,
W87-08994 7C

Kinetics of Sulfate Adsorption and Desorption by Cecil Soil Using Miscible Displacement,
W87-08995 2G

Effect of Tillage System on Runoff Losses of Surface-Applied Pesticides,
W87-09001 2E

Dynamics of Sulfate Retention by Acid Forest Soils in an Acidic Deposition Environment,
W87-09008 5B

First-Order Reliability Approach to Stochastic Analysis of Subsurface Flow and Contaminant Transport,
W87-09017 5B

Mobilization of Aluminum in a Natural Soil System: Effects of Hydrologic Pathways,
W87-09024 5B

Statistical Structure and Filter Characteristics of Tritium Fluctuations in Fractured Basalt,
W87-09027 5B

Simulation of the Borden Plume Using the Alternating Direction Galerkin Technique,
W87-09030 5B

Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization.
W87-09067 2H

Geochemistry of Humic Substances in Estuarine Environments,
W87-09074 2H

Groundwater-Leachate: Modeling/Monitoring/Sampling,
W87-09089 5B

Quality of Urban Runoff,
W87-09102 5B

Report of the Acid Rain Peer Review Panel.
W87-09107 5B

Determining Optimum Pumping Rates for Creation of Hydraulic Barriers to Ground-Water Pollutant Migration,
W87-09108 5G

Leaching Radioactive and Nonradioactive Elements from Actual Savannah River Plant Nuclear Waste Glass,
W87-09112 5B

Development Programs in the United States of America for the Application of Cement-Based Grouts in Radioactive Waste Management,
W87-09113 5E

Modeling of Atmospheric Particulate Deposition to Natural Waters,
W87-09166 5B

Transfer Rates of Gaseous Pollutants Between the Atmosphere and Natural Waters,
W87-09167 5B

Exchange of Particles and Gases Across Water Surfaces,
W87-09168 5B

Mechanisms of Enrichment at the Air-Water Interface,
W87-09169 5B

Principles and Problems of Modeling Cation Enrichment at Natural Air-Water Interfaces,
W87-09170 5B

Organic Matter and Heavy Metal Concentrations in the Particulate Phase of Lake Michigan Surface Microlayers,
W87-09171 5B

Copper in Marine Microlayers: Accumulation, Speciation and Transport,
W87-09172 5B

Atmospheric Deposition of Nitrogen and Phosphorus in Florida,
W87-09175 5B

Importance of Atmospheric Fluxes to the Nitrogen Balance of Lakes in the Florida Peninsula,
W87-09176 2H

Atmospheric Deposition of Acidity and Sulfur in Florida,
W87-09177 5B

Trace Metal and Strong Acid Composition of Rain and Snow in Northern Minnesota,
W87-09178 5B

Transport and Dry Deposition of Trace Metals over Southern Lake Michigan,
W87-09179 5B

Use of Bog Vegetation as a Monitor of Atmospheric Input of Metals,
W87-09182 5C

Rates of Accumulation of Heavy Metals in Pre- and Post-European Sediments in New England Lakes,
W87-09184 5B

Atmospheric Concentrations and Deposition of Polychlorinated Biphenyls to Lake Superior,
W87-09185 5B

Inputs of Polychlorinated Biphenyls from the Atmosphere to Lakes Huron and Michigan,
W87-09186 5B

Atmospheric Deposition of Particulate Organic Carbon and Polyaromatic Hydrocarbons to Lake Michigan,
W87-09187 5B

Aerial Deposition of Organochlorines in Urban and Coastal South Carolina,
W87-09188 5B

Adsorption of Inorganic Pollutants in Aquatic Systems,
W87-09194 5B

Heavy Metals Distribution in the Sediments of Ganges and Brahmaputra Rivers,
W87-09204 5B

Pesticides in Fog,
W87-09229 5B

Disposition of Low and High Environmental Concentrations of PCBs in Snapping Turtle Tissues,
W87-09234 5B

Bioaccumulation Potential of Heterotrophic Bacteria for Lead, Selenium, and Arsenic,
W87-09240 5B

Toxicity and Bioaccumulation of Cadmium in Experimental Cultures of Duckweed, Lemna polyrrhiza L.,
W87-09241 5C

Zinc, Iron, Manganese, and Magnesium Accumulation in Crayfish Populations Near Copper - Nickel Smelters at Sudbury, Ontario, Canada,
W87-09243 5C

Zinc, Copper and Nickel Concentrations in Soil Extracts and Crops Grown on Four Soils Treated with Metal-loaded Sewage Sludges,
W87-09244 5B

Response of Lake Sediments to Changes in Trace Metal Emission from the Smelters at Sudbury, Ontario,
W87-09245 5B

Attempt to Measure the Flow of Chlorinated Hydrocarbons, such as PCBs, from Water to Air in the Field,
W87-09246 7B

Kinetic Models for Predicting Bioaccumulation of Pollutants in Ecosystems,
W87-09247 5B

Investigation into the Retention of 65Zn Absorbed by the Trophic Pathway in Cyprinus Carpio L. Influence of the Ingestion Frequency and the Radiozinc Content of Food (Etude de la Retention Du 65Zn Absorbe par voie Trophique Chez Cyprinus Carpio L. Influence du Rythme D'Ingestion et de la Teneur en Radiozinc de la Nourriture),
W87-09268 5B

Hydrological and Chemical Factors Controlling the Concentrations of Fe, Cu, Zn and As in a River System Contaminated by Acid Mine Drainage,
W87-09277 5B

Fundamentals of Aquatic Toxicology: Methods and Applications.
W87-09280 5C

Bioaccumulation,
W87-09296 5B

Effluent Evaluation,
W87-09302 5A

Groundwater Transport: Handbook of Mathematical Models,
W87-09306 5B

Response of Marine Animals to Petroleum and Specific Petroleum Hydrocarbons,
W87-09308 5C

Septic Tank System Effects on Ground Water Quality,
W87-09310 5C

Decrease in Precipitation Acidity Resulting From Decreased S04(2-) Concentration,
W87-09348 5B

Metal Precipitation in Two Landfill Leachates,
W87-09368 5G

Heavy Metal Concentrations in the Liver of Three Duck Species: Influence of Species and Sex,
W87-09380 5B

Fate of Some Components of Acidic Deposition in Ombrotrophic Mires,
W87-09382 5B

Microbially Mediated Leaching of Low-Sulfur Coal in Experimental Coal Columns,
W87-09393 5B

LLNL Groundwater Quality: Sampling of Seven Shallow Wells on the LLNL Site,
W87-09458 5B

Comprehensive Model for Oil Spill Simulation,
W87-09552 5B

PEAT

90Sr and 137Cs in Peat Deposits of Low-Lying Bog in the Influence Zone of the Beloyarsk Atomic Power Station,
W87-08710 5B

PEAT BOGS

Hydrology, Water Chemistry and Ecological Relations in the Raised Mound of Cowles Bog,
W87-08837 2H

Geochemistry of Humic Substances in Natural and Cultivated Peatlands,
W87-09069 2H

Geochemistry of Humin,
W87-09077 2H

Hydrology and Drainage of Peatland,
W87-09201 2G

Hydrogeological Problems Affecting the Exploitation of the Peat Bog at Padul (Granad, Spain). Preliminary Study (Problemas Hidrogeologicos que Afectan a la Explotacion de la Turbera de Padul (Granad, Espana). Estudio Preliminar),
W87-09576 4A

PEAT CUTTINGS
Plants and Peat Cuttings: Historical Ecology of a Much Exploited Peat land-Thorne Waste. Yorkshire, UK,
W87-09342 4C

PEATLAND RECLAMATION
Plants and Peat Cuttings: Historical Ecology of a Much Exploited Peat land-Thorne Waste. Yorkshire, UK,
W87-09342 4C

PEATLANDS
Vegetation of the Low-Shrub Bogs of Northern New Jersey and Adjacent New York: Ecosystems at Their Southern Limit,
W87-08715 2H

PECOS RIVER
Prehistory of the Carlsbad Basin, Southeastern New Mexico,
W87-09156 6G

PENNSYLVANIA
Hydrogeologic Factors that May Affect Mine Drainage in the Anthracite Region of Pennsylvania, Eastern United States,
W87-09577 4C

PENTACHLOROPHENOL
Removal of Traces of Pentachlorophenol from Aqueous Acidic Solutions by Solvent Extraction and Solvent Sublation,
W87-08605 5D

Analysis of Pentachlorophenol in Water and Urine by Enrichment with Lipidex(R) 5000,
W87-08896 5A

PERCH
Distribution and Relative Abundance of the Nile Perch (Lates niloticus (L.) Pisces: Centropomidae) in Lake Kainji, Nigeria,
W87-08762 2H

PERFORMANCE EVALUATION
Statistical Techniques for Evaluating Procedures and Results for Periphyton Sampling,
W87-09319 7C

Fixed-Cone Valve Prototype Tests, Final Series, New Melones Dam, California,
W87-09483 8C

Pumping Performance and Turbidity Generation of Model 600/100 Pneuma Pump: Main Text and Appendixes A and B,
W87-09487 8C

Laboratory Determination of Dispersant Effectiveness: Method Development and Results,
W87-09509 5G

View of the Laboratory Testing and Assessment of Oil Spill Dispersant Efficiency,
W87-09510 5G

BIOS Project - Frontier Oil Spill Countermeasures Research,
W87-09523 5G

Dome Petroleum's Oil Spill Research and Development Program for the Arctic,
W87-09524 5G

Dome's Petroleum Study of Oil and Gas Under Sea Ice,
W87-09525 5G

Coast Guard Environmental Mission Fulfilled by Naval Salvage, French Frigate Shoals,
W87-09530 5G

Ixtoc I Oil Spill - The Damage Assessment Program and Ecological Impact,
W87-09554 5C

Open Ocean Skimmer Performance Tests,
W87-09562 5G

PERFORMANCE EVALUATIONS
Response to the Esso Bayway Oil Spill,
W87-09549 5G

PERIPHYTON
Method for Measuring Selective Light Attenuation within a Periphytic Community,
W87-08769 7B

Effects of Copper on the Periphyton of a Small Calcareous Stream,
W87-09318 5C

Statistical Techniques for Evaluating Procedures and Results for Periphyton Sampling,
W87-09319 7C

Assessment of Effluent Impacts through Evaluation of Periphyton Diatom Community Structure,
W87-09320 5C

Effects of Exposure Time, Season, Substrate Type, and Planktonic Populations on the Taxonomic Composition of Algal Periphyton on Artificial Substrates in the Ohio and Little Miami Rivers, Ohio,
W87-09321 5C

PERIVITELLINE FLUID
Effects of Low Ambient pH on Perivitelline Fluid of Ambystoma maculatum (Shaw) Eggs,
W87-08963 5C

PERMEABILITY COEFFICIENT
Reduction in Hydraulic Conductivity in Relation to Clay Dispersion and Disaggregation,
W87-08996 2G

PESTICIDE TOXICITY
Impact of Pesticides on Lipid Metabolism in the Freshwater Catfish, Clarias batrachus, during the Vitellogenic Phase of Its Annual Reproductive Cycle,
W87-08851 5C

Pesticide-Induced Changes in Peripheral Thyroid Hormone Levels during Different Reproductive Phases in Heteropneustes fossilis,
W87-08858 5C

Acute Toxicity of Brestan and Fentin Acetate on Some Freshwater Organisms,
W87-08876 5C

Toxicity of Picloram (4-Amino-3,5,6-Trichloropicolinic Acid) to Life Stages of the Rainbow Trout,
W87-08877 5C

Effect of Irrigation on Persistent Toxicity of Insecticides Applied as Granules to Soil to Brown Plant Hopper and Rice Swarming Caterpillar,
W87-08897 5B

Effect of Mosquito Killer Insecticides on Freshwater Mussels,
W87-08908 5C

PESTICIDES
Biological Effects of Continuous and Intermittent Dosing of Outdoor Experimental Streams with Chloropyrifos,
W87-08634 5C

Organochlorine Pesticide Residues in Fish from the Shatt al-Arab River, Iraq,
W87-08880 5B

Effect of Tillage System on Runoff Losses of Surface-Applied Pesticides,
W87-09001 2E

Effective Alternative to Official Regulation of Indirect Additives to Drinking Water,
W87-09120 5F

Removal of Pesticides from Drinking Water with Ozone,
W87-09140 5F

Nonpoint Agricultural Pollution: Pesticide Contamination of Groundwater Supplies,
W87-09213 5B

Pesticides in Fog,
W87-09229 5B

Pesticides,
W87-09291 5C

PHENOLOGY
Seasonality of Blue Mussel, Mytilus edulis L., Larvae in the Damariscotta River Estuary, Maine, 1969-77,
W87-08849 2L

PHENOLS
Comparison of QSAR Predictions with Fish Toxicity Screening Data for 110 Phenols,
W87-08637 5C

Biodegradation of Phenols in an Integrated Activated Carbon Bed and Suspended Aerobic Biological Growth Reactor,
W87-08774 5D

In Vitro Cytotoxicity of Organic Pollutants to Bluegill Sunfish (BF-2) Cells,
W87-08843 5C

Removal of Phenols by Adsorption on Fly Ash,
W87-09250 5D

Biodegradation of Trichloroethylene and Involvement of an Aromatic Biodegradative Pathway,
W87-09387 5D

PHENOXYACETIC ACIDS
Study of the Kinetics of the Adsorption by Activated Carbons of 2,4,5-Trichlorophenoxyacetic Acid from Aqueous Solution,
W87-09251 5D

PHORATE
Effect of Irrigation on Persistent Toxicity of Insecticides Applied as Granules to Soil to Brown Plant Hopper and Rice Swarming Caterpillar,
W87-08897 5B

PHOSPHATES
Influence of Soil Water Content on the Supply of Phosphate to Plants,
W87-08705 2I

Influence of Soil Characteristics and Environmental Conditions on Seasonal Variations of Water-Soluble Phosphate in Soils,
W87-09257 2G

Suppression of Phosphate Liberation from Sediment by Using Iron Slag,
W87-09273 5G

PHOSPHORUS
Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulfur, Micronutrients,
W87-08689 2G

Mathematical Model of Seasonal and Spatial Variation in Phosphorus Concentrations in Lake Memphremagog, Quebec,
W87-08899 5B

Lake Loading Ratios (N:P) and Lacustrine Nitrogen Fixation,
W87-08972 2H

Multiattribute Analysis of the Impact on Society of Phosphorus Abatement Measures,
W87-09013 5G

Input of Biologically Available Phosphorus by Precipitation to Precambrian Lakes,
W87-09174 5B

Atmospheric Deposition of Nitrogen and Phosphorus in Florida,
W87-09175 5B

Suppression of Phosphate Liberation from Sediment by Using Iron Slag,
W87-09273 5G

Enhancement of Inorganic Nitrogen and Phosphate Release from Lake Sediment by Tubificid Worms and Chironomid Larvae,
W87-09404 2H

PHOSPHORUS COMPOUNDS
Correlation of a Lake Eutrophication Model to Field Experiments,
W87-08900 2H

PHOSPHORUS REMOVAL
Enhanced Uptake of Phosphorus by Activated Sludge - Effect of Substrate Addition,
W87-09270 5D

PHOTOCHEMISTRY
Photochemical Transformations,
W87-08682 5B

Role of Cupric Ions in the Generation of Superoxide in Natural Waters,
W87-08716 2K

PHOTOGRAPHY
Measuring Fish Lengths from Instant Photographs Using a Digitizing Tablet and Minicomputer,
W87-08649 7B

Stroboscopic Determination of Settling Velocity, Size and Porosity of Activated Sludge Flocs,
W87-09263 7B

PHOTOLYSIS
Degradation of Aniline and Chloroanilines by Sunlight and Microbes in Estuarine Water,
W87-09271 5B

PHOTOLYTIC OZONATION
Photolytic Ozonation for Protection and Rehabilitation of Ground-Water Resources; A Mechanistic Study,
W87-09092 5G

PHOTOSYNTHESIS
Pattern of Organic Matter Production by Natural Phytoplankton Population in a Eutrophic Lake 1. Intracellular Products,
W87-08767 2H

Photosynthate Distribution by Microplankton in Permanently Ice-Covered Antarctic Desert Lakes,
W87-08872 2H

Hexavalent Chromium Effects on Carbon Assimilation in Selenastrum capricornutum,
W87-08886 5C

Algal Phagotrophy: Regulating Factors and Importance Relative to Photosynthesis in Dinobryon (Chrysophyceae),
W87-08929 2H

Photosynthesis and Light Adaptation in Epiphyte-Macrophyte Associations Measured by Oxygen Microelectrodes,
W87-08935 7B

Water Vapor Uptake and Photosynthesis of Lichens: Performance Differences in Species with Green and Blue-Green Algae as Phycobionts,
W87-09345 2I

Responses of Gas Exchange to Humidity in Populations of Three Herbs from Environments Differing in Atmospheric Water,
W87-09346 2I

Leaf Photosynthesis and Conductance of Selected Triticum Species at Different Water Potentials,
W87-09419 2I

PHOTOSYNTHETIC BACTERIA
Photosynthate Distribution by Microplankton in Permanently Ice-Covered Antarctic Desert Lakes,
W87-08872 2H

PHYSICAL ANALYSIS
Ecology of Estuaries, Volume I: Physical and Chemical aspects,
W87-09066 2H

PHYSICAL PROPERTIES
Physical/Chemical Properties of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin,
W87-08657 5B

Environmental Exposure from Chemicals.
W87-08675 5B

Equilibrium Models for the Initial Integration of Physical and Chemical Properties,
W87-08683 5B

Spatial Variability in Selected Physical Characteristics and Processes in Cross Lake, New York,
W87-08973 2H

PHYSIOLOGICAL ECOLOGY
Digestion of Carbohydrates and Protein by Gammarus mucronatus Say (Amphipoda),
W87-08839 2L

Seasonality of Blue Mussel, Mytilus edulis L., Larvae in the Damariscotta River Estuary, Maine, 1969-77,
W87-08849 2L

PHYSIOLOGICAL STUDIES
Biochemistry/Physiology,
W87-09289 5C

PHYTONEUSTON
Short-Term Effects of Polynuclear Aromatic Hydrocarbons on Sea-Surface Microlayer Phytoneuston,
W87-09238 5C

PHYTOPHTHORA
Effects of Simulated Acidic Mist on Germination of Alternaria solani and Phytophthora infestans in vitro and their Infection Efficiency and Sporulation on Potato,
W87-09414 5C

PHYTOPLANKTON
Pattern of Organic Matter Production by Natural Phytoplankton Population in a Eutrophic Lake 1. Intracellular Products,
W87-08767 2H

Qualitative Model of Eutrophication in Macrophyte Lakes,
W87-08785 2H

Catchment Effects on the Horizontal Distribution of Phytoplankton in Five of Scotland's Largest Freshwater Lochs,
W87-08790 2H

Free Amino Acids in Lakes: Concentrations and Assimilation Rates in Relation to Phytoplankton and Bacterial Production,
W87-08868 2H

Resuspension in the Shallow Sublittoral Zone of a Macrotidal Estuarine Environment: Wind Influence,
W87-08933 2L

Trophic Interactions in the Plankton of Malyi Sevan in July, 1984,
W87-09219 2H

Method for Evaluating the Impact of Radioactivity on Phytoplankton,
W87-09317 5C

PHYTOTOXICITY
Effects of Distillery Waste on the Performance of Cicer arietinum L.,
W87-08873 5C

PICLORAM
Aquatic Hazard Assessment: Picloram,
W87-08643 5C

Toxicity of Picloram (4-Amino-3,5,6-Trichloropicolinic Acid) to Life Stages of the Rainbow Trout,
W87-08877 5C

PIEZOMETRIC HEAD
Influence of Underground Constructions in Crystalline Rock on Groundwater Conditions and the Use of Artificial Recharge to Restore a Lowered Piezometric Surface,
W87-09589 4B

PIGMENTS
Limits of Bioaccumulation of Organic Pigments in Fish: Their Relation to the Partition Coefficient and the Solubility in Water and Octanol,
W87-08853 5B

PILOT PLANTS
Perspectives on the Scale-Up of Impeller Mixers,
W87-09434 5D

Important Issues in the Scale Up of New Processes,
W87-09435 5D

Optimization of Mechanical Aerators in a Hydraulic Two-Phase Flow Model and the Scale-Up of the Results for the Prototype,
W87-09439 5D

Unique Pre-Ozonation - D.E. Filtration Water Treatment Plant Design is Based on Pilot Plant Data,
W87-09443 5F

Modeling for Process Scale-Up of Adsorption and Ion Exchange Systems,
W87-09446 5D

Scale-Up of Direct Filtration (The Wahnbach System),
W87-09447 5F

Scale-Up of a Radium-226 Removal Process,
W87-09448 5D

Relationship Between Bench Scale and Prototype Activated Sludge Systems,
W87-09449 5D

Role of Kinetic Models for the Scale-Up of Biological Processes,
W87-09450 5D

Scale-Up of Activated Sludge and Trickling Filter Processes,
W87-09451 5D

Development of a Competitive Two-Stage Biological Treatment System: Results of Pilot Plants and Full Scale Plants,
W87-09454 5D

Scale-Up Experience with the Waterloo SCP Process in Industrial Biomass Waste Treatment,
W87-09455 5D

PIPES
Internal Hydraulics of Diffusers with Uniform Lateral Momentum Distribution,
W87-09366 8B

PLANKTON
Three Day Study of the Diel Behaviour of Plankton in a Highly Humic and Steeply Stratified Lake,
W87-08766 2H

Photosynthate Distribution by Microplankton in Permanently Ice-Covered Antarctic Desert Lakes,
W87-08872 2H

Trophic Interactions in the Plankton of Malyi Sevan in July, 1984,
W87-09219 2H

Effects of Exposure Time, Season, Substrate Type, and Planktonic Populations on the Taxonomic Composition of Algal Periphyton on Artificial Substrates in the Ohio and Little Miami Rivers, Ohio,
W87-09321 5C

PLANNING
Institutional Analysis in Community Decision-Making: A Case Example from Southern Arizona,
W87-08981 6A

Groundwater Management in France,
W87-09205 2F

PLANT DISEASES
Interaction of Euonymus scale (Homoptera:Diaspididae) Feeding Damage and Severe Water Stress on Leaff Abscission and Growth of Euonymus Fortunei,
W87-09344 2I

Effect of Waterlogging on Infection of Eucalyptus marginata Seedlings by Phytophthora cinnamomi,
W87-09401 2I

Effects of Simulated Acidic Mist on Germination of Alternaria solani and Phytophthora infestans in vitro and their Infection Efficiency and Sporulation on Potato,
W87-09414 5C

PLANT GROWTH
Effects of Flooding, Tilting of Stems, and Ethrel Application on Growth, Stem Anatomy and Ethylene Production of Pinus Densiflora Seedlings,
W87-08797 2I

Effects of Cd(2+) and EDTA on Young Sugar Beets (Beta vulgaris). II. Net Uptake and Distribution of Mg(2+), Ca(2+), and Fe(2+)/Fe(3+),
W87-09228 2I

Influence of Simulated Acidic Rain on Vegetative and Reproductive Tissues of Cucumber (Cucumis sativus L.),
W87-09232 5C

Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XI. Growth of Geum rivale L. and Geum urbanum L. and Soil Chemical Condition in Experimentally Flooded Soil,
W87-09398 2I

Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XII. Growth, Photosynthetic Capacity and Metal Ion Uptake in Salix caprea and S. Cinerea ssp. Oleifolia,
W87-09399 2I

Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XIII. The Effect of Fe(2+) on Photosynthesis and Respiration of Salix caprea and S. cinerea ssp. oleifolia,
W87-09400 2I

Effect of Waterlogging on Infection of Eucalyptus marginata Seedlings by Phytophthora cinnamomi,
W87-09401 2I

PLANT GROWTH SUBSTANCES
Effects of Cd(2+) and EDTA on Young Sugar Beets (Beta vulgaris). II. Net Uptake and Distribution of Mg(2+), Ca(2+), and Fe(2+)/Fe(3+),
W87-09228 2I

PLANT PHYSIOLOGY
Effects of Flooding, Tilting of Stems, and Ethrel Application on Growth, Stem Anatomy and Ethylene Production of Pinus Densiflora Seedlings,
W87-08797 2I

Nitrogenase Activity, Photosynthesis and Nodule Water Potential in Soyabean Plants Experiencing Water Deprivation,
W87-08798 2I

Physiological Responses to Drought of Lolium perenne L.: Measurement of, and Genetic Variation in, Water Potential, Solute Potential, Elasticity and Cell Hydration,
W87-08848 2D

Spring Wheat Growth at High and Low Soil Water with Constricted Upper Roots,
W87-08893 2D

Hormonal Regulation of Protein Synthesis Associated With Salt Tolerance in Plant Cells,
W87-09227 2I

Effects of Cd(2+) and EDTA on Young Sugar Beets (Beta vulgaris). II. Net Uptake and Distribution of Mg(2+), Ca(2+), and Fe(2+)/Fe(3+),
W87-09228 2I

PLANT TISSUES
Influence of Simulated Acidic Rain on Vegetative and Reproductive Tissues of Cucumber (Cucumis sativus L.),
W87-09232 5C

PLANT WATER RELATIONS
Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XI. Growth of Geum rivale L. and Geum urbanum L. and Soil Chemical Condition in Experimentally Flooded Soil,
W87-09398 2I

Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XII. Growth, Photosynthetic Capacity and Metal Ion Uptake in Salix caprea and S. Cinerea ssp. Oleifolia,
W87-09399 2I

Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XIII. The Effect of Fe(2+) on Photosynthesis and Respiration of Salix caprea and S. cinerea ssp. oleifolia,
W87-09400 2I

Effect of Waterlogging on Infection of Eucalyptus marginata Seedlings by Phytophthora cinnamomi,
W87-09401 2I

Changes at Panicle Emergence in the Water Relations of a Wetland and a Dryland Japonica Rice Cultivar Under Wetland Conditions,
W87-09415 2I

PLANT WATER USE
Influence of Soil Water Content on the Supply of Phosphate to Plants,
W87-08705 2I

Influence of Sulfur Gas on Water Loss Rate,
W87-08707 2I

Estimating Water Table Contribution to the Water Supply of Maize,
W87-08740 3F

Water Production Functions for Wheat under Different Environmental Conditions,
W87-08748 3F

Water Use of Eucalypts - A Review with Special Reference to South India,
W87-08749 6G

Effects of Water Stress on Flowering and Fruit Set in Processing-Tomatoes,
W87-08770 2I

Field Water Relations of a Compass Plant, Lactuca serriola L.,
W87-08772 2I

Synthesis of a Simplified Water Use Simulation Model for Predicting Wheat Yields,
W87-09028 2I

Leaf Photosynthesis and Conductance of Selected Triticum Species at Different Water Potentials,
W87-09419 2I

PLANTING MANAGEMENT
Establishing Smooth Cordgrass in Tidal Wetlands,
W87-08806 2I

PLASMIDS
Potential for Transduction of Plasmids in a Natural Freshwater Environment: Effect of Plasmid Donor Concentration and a Natural Microbial Community on Transduction in Pseudomonas aeruginosa,
W87-09390 2H

PLUMES
Velocity Control as a Tool for Optimal Plume Containment in the Equus Beds Aquifer, Kansas,
W87-08982 5G

Distribution of Aromatic Hydrocarbons in Port Valdez, Alaska,
W87-09513 5B

POLAND
Fall of Migratory Fish Populations and Changes in Commercial Fisheries in Impounded Rivers in Poland,
W87-09039 6G

Effect of Recreational Uses Upon Aquatic Ecosystems and Fish Resources,
W87-09060 6G

POLICY INITIATIVES
Innovative State Policies for Aiding Community Water Suppliers,
W87-08951 5F

POLICY MAKING
Irrigated Agriculture and Groundwater Quality--A Framework for Policy Development,
W87-09212 6A

Nonpoint Agricultural Pollution: Pesticide Contamination of Groundwater Supplies,
W87-09213 5B

POLITICAL CONSTRAINTS
Wetlands Policy Crisis: United States and United Kingdom,
W87-09215 6E

POLLEN
Macrofossil and Pollen Representation of Coniferous Trees In Modern Sediments from Washington,
W87-08690 2H

POLLUTANT IDENTIFICATION
Electrochemical Analysis of Organic Pollutants,
W87-08612 5A

Determination of Cobalt, Copper, Mercury, and Nickel as Bis(2-hydroxyethyl)dithiocarbamate Complexes by High-Performance Liquid Chromatography,
W87-08831 5A

Determination of Trace Metals in a River Water Reference Material by Inductively Coupled Plasma Mass Spectrometry,
W87-08832 5A

Spectrophotometric Determination of Traces of Silicon in Water after Collection as Silicomolybdenum Blue on an Organic-Solvent-Soluble Membrane Filter,
W87-08833 5A

Trees as Indicators of Subterranean Water Flow from a Retired Radioactive Waste Disposal Site,
W87-08845 5A

Metal-Binding Protein in the Pacific Oyster, Crassostrea gigas: Assessment of the Protein as a Biochemical Environmental Indicator,
W87-08885 5A

Research in Environmental Pollution: II. Determination of Polychlorinated Nitrobenzenes (PCNB's) in Main River Fish,
W87-08895 5A

Occurrence, Significance, and Detection of Klebsiella in Water Systems,
W87-08958 5A

Concentrations of Mercury in Near Shore Surface Waters of the Bay of Biscay and in the Gironde Estuary,
W87-08961 5A

Implications of Elemental Characteristics of Humic Substances,
W87-09084 7B

Improved Monitoring Techniques to Assess Groundwater Quality Near Sources of Contamination,
W87-09126 5A

NBS Environmental Standard Reference Materials for Use in Validating Water Analysis,
W87-09127 5A

Chemistry of Natural Waters,
W87-09149 2K

Regulatory Identification of Petroleum Hydrocarbons in Dredged Material,
W87-09154 5A

Concentration of Giardia Cysts from Water by a Centrifugal Cream Separator,
W87-09209 5A

Analytical Chemistry,
W87-09295 5B

Instrumentation for Environmental Monitoring, Volume 2: Water,
W87-09303 5A

Simultaneous Determination of Linear Alkylbenzenesulfonates, Alkylphenol Polyethoxylates, and Nonylphenol by High-Performance Liquid Chromatography,
W87-09343 5A

Antibiotic-Resistant Pseudomonas in Bottled Drinking Water,
W87-09424 5F

Guidelines for Sampling and Analyzing Solutions from Aquifer Thermal-Energy-Storage Systems,
W87-09457 5A

POLLUTANT LOAD
Model for Estimating the Loading Rate of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin to the Great Lakes,
W87-08660 5B

POLLUTION CONTROL
Multiattribute Analysis of the Impact on Society of Phosphorus Abatement Measures,
W87-09013 5G

POLYCHAETES
Comparative Kinetics for Bioaccumulation of Polychlorinated Biphenyls by the Polychaete (Capitella capitata) and Fish (Mugil cephalus),
W87-08856 5B

POLYCHLORINATED BIPHENYLS
Embryotoxicity, Teratogenicity, and Aryl Hydrocarbon Hydroxylase Activity in Forster's Terns on Green Bay, Lake Michigan,
W87-08841 5C

Comparative Kinetics for Bioaccumulation of Polychlorinated Biphenyls by the Polychaete (Capitella capitata) and Fish (Mugil cephalus),
W87-08856 5B

Atmospheric Concentrations and Deposition of Polychlorinated Biphenyls to Lake Superior,
W87-09185 5B

Inputs of Polychlorinated Biphenyls from the Atmosphere to Lakes Huron and Michigan,
W87-09186 5B

Disposition of Low and High Environmental Concentrations of PCBs in Snapping Turtle Tissues,
W87-09234 5B

Attempt to Measure the Flow of Chlorinated Hydrocarbons, such as PCBs, from Water to Air in the Field,
W87-09246 7B

Quantification of PCB by Dechlorination to Biphenyl,
W87-09259 5A

POLYELECTROLYTES
Determination of Low Levels of Cationic Polyelectrolytes in Water,
W87-08986 5A

POLYNUCLEAR AROMATIC COMPOUNDS
Characterization of the PAC Profile in Settling Particulates from the Urban Waters of Stockholm,
W87-09237 5B

POLYNUCLEAR AROMATIC HYDROCARBONS
Short-Term Effects of Polynuclear Aromatic Hydrocarbons on Sea-Surface Microlayer Phytoneuston,
W87-09238 5C

POME
Stochastic Model for Sediment Yield Using the Principle of Maximum Entropy,
W87-09016 2J

POND SEDIMENTS
Macrofossil and Pollen Representation of Coniferous Trees In Modern Sediments from Washington,
W87-08690 2H

PONDS
Effects of Low Ambient pH on Perivitelline Fluid of Ambystoma maculatum (Shaw) Eggs,
W87-08963 5C

Comparison of Toxicity Tests Conducted in the Laboratory and in Experimental Ponds using Cadmium and the Fathead Minnow (Pimephales promelas),
W87-09272 5C

POOLS
Prediction of the Occurrence of Four Species of Mosquito Larvae with Logistic Regression on Water-Chemistry Variables,
W87-08846 2H

POPULATION DENSITY
Effect of Polluted and Leached Snow Melt Waters on the Soil Bacterial Community--Quantitative Response,
W87-08874 5C

Growth of Mixed Microbial Populations in Ground Water Containing Highly Chlorinated Organic Wastes,
W87-08878 5B

POPULATION DYNAMICS
Ecological and Physiological Differentiation Among Low-Arctic Clones of Daphnia Pulex,
W87-08691 2H

Ecological and Statistical Prognosis of the Dynamics of Fish Catch Based on Dendrochronological Data,
W87-08711 2H

Distribution and Relative Abundance of the Nile Perch (Lates niloticus (L.) Pisces: Centropomidae) in Lake Kainji, Nigeria,
W87-08762 2H

Effects of Food Availability and Fish Predation on a Zooplankton Community,
W87-08799 2H

Ecology of a Cryptomonas phaseolus Population Forming a Metalimnetic Bloom in Lake Ciso, Spain: Annual Distribution and Loss Factors,
W87-08930 2H

Distribution of Protozoa in Subsurface Sediments of a Pristine Groundwater Study Site in Oklahoma,
W87-09395 2H

POPULATION EXPOSURE
Age-Dependent Lung Doses from Ingested 222Rn in Drinking Water,
W87-08844 5C

Exposure to Legionella in Geriatric Institutions,
W87-08907 5B

POPULATIONS
Theory of Secondary Production Calculations for Continuously Reproducing Populations,
W87-08862 2L

POROUS MEDIA
Gravity Drainage Analysis for Scale Heterogeneous Porous Materials Under Falling Water Table Conditions,
W87-09020 2G

POROUS MEMBRANES
Applications of Porous Membranes for Biomass Retention in Biological Wastewater Treatment Processes,
W87-08889 5D

PORTTIPAHTA RESERVOIR
Fish Stocks and Fishing in the Lokka and Porttipahta Reservoirs, Northern Finland,
W87-09056 2H

PORTUGAL
Geochemical Studies in the Drainage Basin of the Rio Vouga, Portugal. IV. Impact of Land Use on the Hydrogeochemistry of Natural Waters in the Vouzela Region,
W87-09207 4C

Roman Dams in Southern Portugal,
W87-09411 6E

POST-FRONTAL PRECIPITATION
Longer-Duration Post-Frontal Precipitation at Vancouver International Airport, 1953-1983,
W87-08809 2B

POTABLE WATER
Carcinogenic Effects in A/J Mice of Particulate of a Coal Tar Paint Used in Potable Water Systems,
W87-08613 5C

Bacteriological Quality of Drinks From Vending Machines,
W87-08704 5F

Seasonality of Legionella Isolates from Environmental Sources,
W87-08902 2H

Seasonal Distribution of Legionellae Isolated from Various Types of Water in Israel,
W87-08903 5A

Association between Legionella pneumophila and Amoebae in Water,
W87-08906 5F

POTASSIUM FERRIOXALATE
Potassium Ferrioxalate as Chemical Actinometer in Ultraviolet Reactors,
W87-09377 5F

POTATOES
Impact of Simulated Acidic Precipitation on Quantity and Quality of a Field Grown Potato Crop,
W87-08789 5C

Effects of Simulated Acidic Mist on Germination of Alternaria solani and Phytophthora infestans in vitro and their Infection Efficiency and Sporulation on Potato,
W87-09414 5C

POTOMAC RIVER
Restoration of Oiled Marshes Through Sediment Stripping and Spartina Propagation,
W87-09546 5G

POWERPLANTS
Managing Powerplant Combustion Wastes,
W87-08803 5E

Power-Plant-Related Estuarine Zooplankton Studies,
W87-09316 5C

PRECAMBRIAN LAKES
Input of Biologically Available Phosphorus by Precipitation to Precambrian Lakes,
W87-09174 5B

PRECIPITATES
Metal Precipitation in Two Landfill Leachates,
W87-09368 5G

PRECIPITATION
Impact of Mesoscale Convective Systems on Regional Visibility and Oxidant Distributions during Persistent Elevated Pollution Episodes,
W87-08695 2B

Impact of Simulated Acidic Precipitation on Quantity and Quality of a Field Grown Potato Crop,
W87-08789 5C

Longer-Duration Post-Frontal Precipitation at Vancouver International Airport, 1953-1983,
W87-08809 2B

Supply of Snow in the Eastern Highlands of Scotland: 1954-5 to 1983-4,
W87-08810 2C

Correction of Liquid Precipitation,
W87-08813 2B

Estimation of Canopy Reservoir Capacity and Oxygen-18 Fractionation in Throughfall in a Pine Forest,
W87-08814 2B

Markov Renewal Model for Rainfall Occurrences,
W87-09025 7C

Statistical Modeling of Daily Rainfall Occurrences,
W87-09026 7C

Input of Biologically Available Phosphorus by Precipitation to Precambrian Lakes,
W87-09174 5B

SCPP Meteorological and Statistical Support for Period 1 September 1985, 31 August 1986, Volume I: Interim Progress Report,
W87-09334 2B

Free Amino Acids in Marine Rains: Evidence for Oxidation and Potential Role in Nitrogen Cycling,
W87-09349 2B

Climate Forecast Verifications, U.S. Mainland, 1974-82,
W87-09499 2B

PRECIPITATION EXCESS
Longer-Duration Post-Frontal Precipitation at Vancouver International Airport, 1953-1983,
W87-08809 2B

PREDATION
Predation Risk and Use of Intertidal Habitats by Young Fishes and Shrimp,
W87-08787 2L

Effects of Food Availability and Fish Predation on a Zooplankton Community,
W87-08799 2H

PREDICTION
Comparison of QSAR Predictions with Fish Toxicity Screening Data for 110 Phenols,
W87-08637 5C

Prediction of the Occurrence of Four Species of Mosquito Larvae with Logistic Regression on Water-Chemistry Variables,
W87-08846 2H

Understanding the Origin of Radon Indoors--Building a Predictive Capability,
W87-08888 5B

PRESSURE
Programmed Closing of Gates Upon Loss of Drive by a Pump Unit,
W87-09355 8C

PRESSURE SEWERS
Design and Use of Pressure Sewer Systems,
W87-09309 5D

PRETORIA
15N/14N Ratios of Nitrate and Ammonium in Rain at Pretoria, South Africa,
W87-08944 2B

PRICING
Metropolitan Water Management,
W87-09338 6D

PRIMARY PRODUCTIVITY
Free Amino Acids in Lakes: Concentrations and Assimilation Rates in Relation to Phytoplankton and Bacterial Production,
W87-08868 2H

Simultaneous Measurement of Primary Production by Whole-Lake and Bottle Radiocarbon Additions,
W87-08931 2H

Examination of Tidal Flats, Vol. 1: Research Report.
W87-09492 4C

PRIMARY WASTEWATER TREATMENT
Puerto Rico Seeks Clean Water,
W87-08802 5D

PRIORITY POLLUTANTS
Short-Term Effects of Polynuclear Aromatic Hydrocarbons on Sea-Surface Microlayer Phytoneuston,
W87-09238 5C

PROBABILISTIC PROCESS
Markov Renewal Model for Rainfall Occurrences,
W87-09025 7C

Statistical Modeling of Daily Rainfall Occurrences,
W87-09026 7C

PROBABILITY MODELS
Overtopping Risk for an Existing Dam,
W87-09461 8A

PRODUCTIVITY
Effect of Soil Slip Erosion on Wairoa Hill Pasture Production and Composition,
W87-08734 2J

Perennial Pasture Production after Irrigation with Saline Groundwater in the Goulburn Valley, Victoria,
W87-09208 3C

PROJECT PLANNING
Example Model Applications,
W87-09105 4C

Natural Propagation and Habitat Improvement - Washington, Volume IIA - Tumwater Falls and Dryden Dam Fish Passage.
W87-09109 8I

Small-Scale Hydroelectric Power.
W87-09110 6A

Archaeological and Historical Surveys of Selected Portions of the Umatilla Basin Project, Umatilla County, Oregon,
W87-09425 6G

Effects of Storage Reallocation on Thermal Characteristics of Cowanesque Lake, Pennsylvania: Numerical Model Investigation,
W87-09485 2H

Examination of Tidal Flats, Vol. 3: Evaluation Methodology.
W87-09493 4C

Proposed Hydrogeological Model for Future Lignite Mining and Groundwater Drainage in the Hula Basin, Northern Israel,
W87-09578 2F

Groundwater Control in Opencast Mining of a Lignite Deposit in Southern Greece,
W87-09583 4B

Plans and Experiments to Deal with Large Amounts of Sediment in Hungarian Mines under Karstic Water Hazard,
W87-09590 4C

PROTEINS
Digestion of Carbohydrates and Protein by Gammarus mucronatus Say (Amphipoda),
W87-08839 2L

Metal-Binding Protein in the Pacific Oyster, Crassostrea gigas: Assessment of the Protein as a Biochemical Environmental Indicator,
W87-08885 5A

Hormonal Regulation of Protein Synthesis Associated With Salt Tolerance in Plant Cells,
W87-09227 2I

Glutathione Status and Protein Synthesis During Drought and Subsequent Rehydration in Tortula ruralis,
W87-09417 2I

PROTOTYPE TESTS
Fixed-Cone Valve Prototype Tests, Final Series, New Melones Dam, California,
W87-09483 8C

PROTOTYPES
Fixed-Cone Valve Prototype Tests, Final Series, New Melones Dam, California,
W87-09483 8C

PROTOZOA
Association between Legionella pneumophila and Amoebae in Water,
W87-08906 5F

Seasonal Distribution of Thermotolerant Free-Living Amoebae. II. Lake Issaqueena,
W87-09225 2H

Use of Monodispersed, Fluorescently Labeled Bacteria to Estimate In Situ Protozoan Bacterivory,
W87-09388 2H

Distribution of Protozoa in Subsurface Sediments of a Pristine Groundwater Study Site in Oklahoma,
W87-09395 2H

PROVO RIVER
Prehistoric Cultural Resources Study Predictive Model and Field Survey Weber Basin Project,
W87-09335 6G

PSEUDOMONAS
Comparison of Techniques for Evaluating the Effect of Cadmium on Pseudomas Fluorescens,
W87-08648 5C

Potential for Transduction of Plasmids in a Natural Freshwater Environment: Effect of Plasmid Donor Concentration and a Natural Microbial Community on Transduction in Pseudomonas aeruginosa,
W87-09390 2H

Antibiotic-Resistant Pseudomonas in Bottled Drinking Water,
W87-09424 5F

PUBLIC HEALTH
Outbreak of Legionnaires' Disease in Glasgow Royal Infirmary: Microbiological Aspects,
W87-08703 5C

Water Use and Health in Mueda, Mozambique,
W87-08777 5F

Knowledge Attitudes and Practices in Relation to Schistosomiasis in a Rural Community,
W87-08778 5F

Presence of Legionella in London's Water Supplies,
W87-08901 5F

Exposure to Legionella in Geriatric Institutions,
W87-08907 5B

Occurrence, Significance, and Detection of Klebsiella in Water Systems,
W87-08958 5A

Chemicals and Safe Drinking Water: National and International Perspective,
W87-09115 5C

Drinking Water: A Global Victual,
W87-09116 5C

Public Drinking Water and Chemicals,
W87-09117 5C

Bottled Water: An Alternative Source of Safe Drinking Water,
W87-09118 5F

Concentration of Giardia Cysts from Water by a Centrifugal Cream Separator,
W87-09209 5A

Relationship Between Water-System Size and 222Rn Concentration in North Carolina Public Water Supplies,
W87-09218 5F

Public Health Significance of Industrial Pollution in Zaria, Nigeria,
W87-09226 5B

Survival and Multiplication of Legionella pneumophila in Municipal Drinking Water Systems,
W87-09389 5F

PUBLIC PARTICIPATION
Hydrogeological Aspects of Coal Mining Under Stored Waters Near Sydney, Australia,
W87-09587 2F

PUBLIC POLICY
Groundwater Management in France,
W87-09205 2F

Wetlands Policy Crisis: United States and United Kingdom,
W87-09215 6E

PUERTO RICO
Fate of the Zoe Colocotroni Oil Spill and its Effects on Infaunal Communities Associated with Mangroves,
W87-09544 5C

PULP AND PAPER INDUSTRY
Dynamics of Nitrogen and Carbon in Soil during Papermill Sludge Decomposition,
W87-08891 5E

Formation of Toxaphene-Like Contaminants During Simulated Paper Pulp Bleaching,
W87-09093 5B

PULP WASTES
Long-Term Effects of Bleached Kraft Mill Effluents on Carbohydrate Metabolism and Hepatic Xenobiotic Biotransformation Enzymes in Fish,
W87-08854 5C

PULSED NUCLEAR MAGNETIC RESONANCE
Pulsed Nuclear Magnetic Resonance Instrument for Soil-Water Content Measurement: Sensor Configurations,
W87-08991 7B

PUMP TESTING
Pumping Performance and Turbidity Generation of Model 600/100 Pneuma Pump: Main Text and Appendixes A and B,
W87-09487 8C

PUMP WELLS
Groundwater Control in Opencast Mining of a Lignite Deposit in Southern Greece,
W87-09583 4B

PUMPING
Preliminary Hydrogeological Study of the Reocin Mine (Santander, Spain) (Estudio Hidrogeologico Preliminar de la Mina de Reocin (Santander, Espana)),
W87-09579 2F

Mine and Open Pit Dewatering at Chingola, Zambia,
W87-09584 4B

PUMPING PLANTS
Ammonia, Hydrogen Sulphide and Methyl Mercaptides in Finnish Municipal Sewage Plants and Pumping Stations,
W87-08725 5D

Archaeological and Historical Surveys of Selected Portions of the Umatilla Basin Project, Umatilla County, Oregon,
W87-09425 6G

Attempts to Determine the Viability of a Deep Excavation on the Coast of the Vandellos Massif (Tarragona, Spain) (Ensayos Para Determinar la Viabilidad de una Excavacion Profunda en el Litoral del Macizo de Vandellos (Tarragona, Expana)),
W87-09574 2F

PUMPING TESTS
Alternate Procedure for Analyzing Aquifer Tests Using the Theis Nonequilibrium Solution,
W87-08756 7C

PUMPS
Programmed Closing of Gates Upon Loss of Drive by a Pump Unit,
W87-09355 8C

Pumping Performance and Turbidity Generation of Model 600/100 Pneuma Pump: Main Text and Appendixes A and B,
W87-09487 8C

PURGING
Monitoring Well Installation, Purging, and Sampling Techniques - Part 1: Conceptualizations,
W87-08755 7B

QSAR
Research Needs in Developing Structure Activity Relationships,
W87-08633 5C

Comparison of QSAR Predictions with Fish Toxicity Screening Data for 110 Phenols,
W87-08637 5C

QUANTITATIVE STRUCTURE ACTIVITY RELATIONSHIPS
Comparison of QSAR Predictions with Fish Toxicity Screening Data for 110 Phenols,
W87-08637 5C

QUEBEC
Mathematical Model of Seasonal and Spatial Variation in Phosphorus Concentrations in Lake Memphremagog, Quebec,
W87-08899 5B

Rainfall Acidity as Related to Meteorological Parameters in Northern Quebec,
W87-08943 2B

QUEENSLAND
Effects of Pollution by Organic Sugar Mill Effluent on the Macro-invertebrates of a Stream in Tropical Queensland, Australia,
W87-09421 5C

RADAR
Application of Meteorological Radar Data for Simulation of Streamflow with a Hydrological Matrix Model (Utilisation des Donnees d'un Radar Meteorologique pour la Simulation des

Ecoulements en Riviere a l'aide d'un Modele Hydrologique Matriciel),
W87-08623 7B

Relative Accuracy of Satellite and Raingage Rainfall Measurements over Middle Latitudes during Daylight Hours,
W87-08700 2B

Tropical Squall Line Observed During the COPT 81 Experiment in West Africa. Part I: Kinematic Structure Inferred from Dual-Doppler Radar Data,
W87-08939 2B

Radar Rainfall Data Quality Control by the Influence Function Method,
W87-09022 7C

RADIOACTIVE TRACERS
Application of Isotope Techniques and Well Loggind in Investigating Ground Water Influenced by Mining,
W87-09580 2F

RADIOACTIVE WASTE DISPOSAL
Geologic Isolation of High-Level Radioactive Waste: Putting It Away Forever,
W87-08805 5E

Trees as Indicators of Subterranean Water Flow from a Retired Radioactive Waste Disposal Site,
W87-08845 5A

Statistical Structure and Filter Characteristics of Tritium Fluctuations in Fractured Basalt,
W87-09027 5B

Development Programs in the United States of America for the Application of Cement-Based Grouts in Radioactive Waste Management,
W87-09113 5E

RADIOACTIVE WASTES
Leaching Radioactive and Nonradioactive Elements from Actual Savannah River Plant Nuclear Waste Glass,
W87-09112 5B

Development Programs in the United States of America for the Application of Cement-Based Grouts in Radioactive Waste Management,
W87-09113 5E

RADIOACTIVITY
Method for Evaluating the Impact of Radioactivity on Phytoplankton,
W87-09317 5C

RADIOISOTOPES
90Sr and 137Cs in Peat Deposits of Low-Lying Bog in the Influence Zone of the Beloyarsk Atomic Power Station,
W87-08710 5B

Relationship Between Water-System Size and 222Rn Concentration in North Carolina Public Water Supplies,
W87-09218 5F

Scale-Up of a Radium-226 Removal Process,
W87-09448 5D

RADIONUCLIDES
Sedimentation and Bioturbation in a Salt Marsh as Revealed by 210Pb, 137Cs, and 7Be Studies,
W87-08932 2L

Investigation into the Retention of 65Zn Absorbed by the Trophic Pathway in Cyprinus Carpio L. Influence of the Ingestion Frequency and the Radiozinc Content of Food (Etude de la Retention Du 65Zn Absorbe par voie Trophique Chez Cyprinus Carpio L. Influence du Rythme D'Ingestion et de la Teneur en Radiozinc de la Nourriture),
W87-09268 5B

RADON
Understanding the Origin of Radon Indoors--Building a Predictive Capability,
W87-08888 5B

Relationship Between Water-System Size and 222Rn Concentration in North Carolina Public Water Supplies,
W87-09218 5F

RADON RADIOISOTOPES
Age-Dependent Lung Doses from Ingested 222Rn in Drinking Water,
W87-08844 5C

Role of Gas Exchange in the Inorganic Carbon, Oxygen, and 222Rn Budgets of the Amazon River,
W87-08871 2H

RAGWEED
Growth and Survival of Giant Ragweed (Ambrosia trifida L.) in a Delaware River Freshwater Tidal Wetland,
W87-08714 2H

RAIN GAGES
Relative Accuracy of Satellite and Raingage Rainfall Measurements over Middle Latitudes during Daylight Hours,
W87-08700 2B

RAINFALL
Application of Meteorological Radar Data for Simulation of Streamflow with a Hydrological Matrix Model (Utilisation des Donnees d'un Radar Meteorologique pour la Simulation des Ecoulements en Riviere a l'aide d'un Modele Hydrologique Matriciel),
W87-08623 7B

Rainfall Kinetic Energy in Eastern Australia,
W87-08698 2B

Groundwater Recharge and Discharge Response to Rainfall on a Hillslope,
W87-08706 2F

Some Metals and Their Possible Sources in Rain Water of the Southern Baltic Coast, 1976 and 1978-1980,
W87-08726 5B

Rainfall in the Wet-Dry Tropics: Extreme Events at Darwin and Similarities Between Years During the Period 1870-1983 Inclusive,
W87-08775 2B

Rainfall Pattern Associated with a Split Cold Front as Seen on FRONTIERS,
W87-08800 2B

Longer-Duration Post-Frontal Precipitation at Vancouver International Airport, 1953-1983,
W87-08809 2B

Correction of Liquid Precipitation,
W87-08813 2B

Estimation of Canopy Reservoir Capacity and Oxygen-18 Fractionation in Throughfall in a Pine Forest,
W87-08814 2B

Rainfall Acidity as Related to Meteorological Parameters in Northern Quebec,
W87-08943 2B

15N/14N Ratios of Nitrate and Ammonium in Rain at Pretoria, South Africa,
W87-08944 2B

Steady-State Analysis of Infiltration and Overland Flow for Spatially-Varied Hillslopes,
W87-08974 2E

Radar Rainfall Data Quality Control by the Influence Function Method,
W87-09022 7C

Markov Renewal Model for Rainfall Occurrences,
W87-09025 7C

Statistical Modeling of Daily Rainfall Occurrences,
W87-09026 7C

Physical Changes Induced by Rainfall in the Surface Layer of an Alfisol, Northern Nigeria,
W87-09214 2G

RAINFALL ANALYSIS
Two New Ground-Level Cloud Water Sampler Designs Which Reduce Rain Contamination,
W87-08948 7B

Theory and Practice in the Electrometric Determination of pH in Precipitation,
W87-08949 7B

RAINFALL DISTRIBUTION
Rainfall Pattern Associated with a Split Cold Front as Seen on FRONTIERS,
W87-08800 2B

RAINFALL DURATION
Longer-Duration Post-Frontal Precipitation at Vancouver International Airport, 1953-1983,
W87-08809 2B

RAINFALL IMPACT
Relationships Between Waterdrop Properties and Forces of Impact,
W87-09004 2J

RAINFALL INTENSITY
Rainfall Kinetic Energy in Eastern Australia,
W87-08698 2B

Relative Accuracy of Satellite and Raingage Rainfall Measurements over Middle Latitudes during Daylight Hours,
W87-08700 2B

RAINFALL INTERCEPTION
Interception Losses of Rainfall from Cashew Trees,
W87-08621 2I

RAINFALL-RUNOFF RELATIONSHIPS
Interception Losses of Rainfall from Cashew Trees,
W87-08621 2I

Laboratory Experiment on the Role of Grass for Infiltration and Runoff Processes,
W87-08622 2A

Groundwater Recharge and Discharge Response to Rainfall on a Hillslope,
W87-08706 2F

Soil Water Balance Model for Sloping Land,
W87-08735 2A

Linear Regression Model Combined with a Soil Water Balance Model to Design Micro-Catchments for Water Harvesting in Arid Zones,
W87-08738 3B

Modelling Water Exchange and Transit Times in Till Basins Using Oxygen-18,
W87-08821 2A

Runoff Studies in a Small Catchment,
W87-08822 2E

Operational Spring Time Forecasting Difficulties and Improvements,
W87-08824 2E

Steady-State Analysis of Infiltration and Overland Flow for Spatially-Varied Hillslopes,
W87-08974 2E

Urban Stormwater Hydrology.
W87-09096 4C

RAISED BOGS
Plants and Peat Cuttings: Historical Ecology of a Much Exploited Peat land-Thorne Waste. Yorkshire, UK,
W87-09342 4C

RANA
Growth and Development of Rana arvalis in Conditions Imitating Oil Contamination,
W87-08713 5C

Use of Bullfrogs (Rana catesbeiana) as Biological Markers for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin Contamination in the Environment,
W87-08733 5A

Lethal Effects of Diquat and Paraquat on Developing Frog Embryos and 15-Day-Old Tadpoles, Rana pipiens,
W87-09235 5C

RANDENIGALA PROJECT
Sri Lanka's Randenigala Project,
W87-09412 8A

RARITAN BAY
Heavy Metal Concentrations in the Liver of Three Duck Species: Influence of Species and Sex,
W87-09380 5B

RAW WATER
Raw Water Preozonation,
W87-09145 5F

RECESSION CURVE
Estimating Baseflow Volume and its Uncertainty,
W87-08971 2E

RECHARGE
Estimation of Groundwater Recharge in Sandy Till with Two Different Methods Using Groundwater Level Fluctuations,
W87-08615 2F

RECLAIMED WATER
Hydraulic/Chemical Changes During Ground-Water Recharge by Injection,
W87-08751 5B

RECREATION
Effect of Recreational Uses Upon Aquatic Ecosystems and Fish Resources,
W87-09060 6G

Trihalomethane Formation in Whirlpool Spas,
W87-09276 5B

Evaluations of the Recreational Potential of Reservoirs in Design Practice,
W87-09360 2H

RECREATION DEMAND
Exploring Existence Value,
W87-09031 6C

Valuing Wildlife in Benefit-Cost Analyses: A Case Study Involving Endangered Species,
W87-09032 6B

Estimating the Value of Water Quality Improvements in a Recreational Demand Framework,
W87-09033 6C

Modeling the Demand for Outdoor Recreation,
W87-09034 6D

RECYCLING
Omaha Recycles Sludge in Agricultural Program,
W87-08808 5E

REFERENCE STANDARDS
Environmental Specimen Bank Specific Reference Materials - Main Aims and Preparation,
W87-08918 5A

REFORESTATION
Afforestation and Fisheries,
W87-09061 4C

REGRESSION ANALYSIS
Advantages of Using Regression Analysis to Calculate Results of Chronic Toxicity Tests,
W87-08650 5C

Prediction of the Occurrence of Four Species of Mosquito Larvae with Logistic Regression on Water-Chemistry Variables,
W87-08846 2H

Empirical Prediction of the Summer Monsoon Rainfall over India,
W87-08940 2B

Relationship of Low-Level Winds and Moisture to Convection in the Tropical Pacific,
W87-08941 2B

Elimination of Time Assignment Bias in Estimates of Dispersion Coefficient,
W87-08994 7C

REGULATIONS
Water Quality Criteria: Protection of Use Perspective,
W87-08629 5G

New Approach for Regulating Iron in Water Quality Standards,
W87-08636 5G

Regulatory Dilemmas Ensnare Arizona's Small Water Companies,
W87-08952 5F

Committee Report: Microbiological Considerations for Drinking Water Regulation Revisions,
W87-08959 5F

Regulation of Contaminants In Drinking Water,
W87-09128 5F

Structure and Regulation of the European Bottled Water Industry,
W87-09132 5F

Irrigated Agriculture and Groundwater Quality--A Framework for Policy Development,
W87-09212 6A

REMOTE SENSING
Application of Meteorological Radar Data for Simulation of Streamflow with a Hydrological Matrix Model (Utilisation des Donnees d'un Radar Meteorologique pour la Simulation des Ecoulements en Riviere a l'aide d'un Modele Hydrologique Matriciel),
W87-08623 7B

Relative Accuracy of Satellite and Raingage Rainfall Measurements over Middle Latitudes during Daylight Hours,
W87-08700 2B

Temporal Observations of Surface Soil Moisture Using A Passive Microwave Sensor,
W87-08781 2G

Remote Sensing: Principles and Interpretation,
W87-09065 7B

REPRODUCTION
Sensitivity of Chronic Endpoints Used in Daphnia Magna Straus Life-Cycle Tests,
W87-08642 5C

Life Cycles of Four Species of Baetis (Ephemeroptera) in Three Danish Streams,
W87-08764 2H

RESEARCH PRIORITIES
Research Needs for Rapid Assessments of Chronic Toxicity,
W87-08630 5C

Research Needs in Validating and Determining the Predictability of Laboratory Data to the Field,
W87-08631 5C

Multispecies Tests: Research Needs to Assess the Effects of Chemicals on Aquatic Life,
W87-08632 5A

Research Needs in Developing Structure Activity Relationships,
W87-08633 5C

1984 Annual Report to the President and Congress: National Acid Precipitation Assessment Program.
W87-09479 5B

RESERVOIR ENLARGEMENT
Geotechnical Aspects of Corani Reservoir Enlargement,
W87-08794 8A

RESERVOIR FISHERIES
Natural Propagation and Habitat Improvement - Washington, Volume IIA - Tumwater Falls and Dryden Dam Fish Passage.
W87-09109 8I

RESERVOIR OPERATION
Dependence of River Pollution on Streamflow Regulation by Reservoirs,
W87-09361 5G

RESERVOIRS
Hydrogen Sulfide Poisonings in Hot-Spring Reservoir Cleaning: Two Case Reports,
W87-08614 5C

Ecological Modelling of a High Mountain Reservoir in Relation to Particulate Organic Matter Loading,
W87-08786 2H

Giant Water Tank Rises in Austin,
W87-08801 5F

Temperature and Flow Conditions in a Reservoir with a Submerged Outlet Tunnel During the Winter Period,
W87-08828 2H

Groundwater Modelling for Hydropower Development in Iceland,
W87-08829 2F

Sedimentation in Lake Onalaska, Navigation Pool 7, Upper Mississippi River, Since Impoundment,
W87-08969 2J

Fall of Migratory Fish Populations and Changes in Commercial Fisheries in Impounded Rivers in Poland,
W87-09039 6G

Effects of Impoundment and Regulation of the River Tees at Cow Green (Northern Pennines, UK) Upon Fish Populations in Afferent Tributaries and in the River Immediately Downstream of the Dam,
W87-09040 6G

Report on Additional Human Skeletal Material Exposed by Reservoir Induced Erosion at Lake Altus, Southwestern Oklahoma,
W87-09161 6G

Evaluations of the Recreational Potential of Reservoirs in Design Practice,
W87-09360 2H

Dependence of River Pollution on Streamflow Regulation by Reservoirs,
W87-09361 5G

Monitoring Programme for Embankment Dams,
W87-09409 8A

Overtopping Risk for an Existing Dam,
W87-09461 8A

Limnological Investigations: Lake Koocanusa, Montana; Part 3: Basic Data, Post-Impoundment, 1972-1978,
W87-09463 2H

Information Retrieval System: Impacts of Water-Level Changes on Uses of Federal Storage Reservoirs of the Columbia River; Appendix F: RIVOPR User's Manual,
W87-09477 10B

Investigation and Discussion of Techniques for Hypolimnion Aeration/Oxygenation,
W87-09481 5G

Evaluation of the Model CE-QUAL-R1 for Use by the Aquatic Plant Control Research Program,
W87-09486 5B

Developments in LARM2: A Longitudinal-Vertical, Time-Varying Hydrodynamic Reservoir Model,
W87-09489 8B

RESIDUAL CHLORINE

Survival and Multiplication of Legionella pneumophila in Municipal Drinking Water Systems,
W87-09389 5F

RESINS

Application of New Chemical Grouts in Strengthening and Sealing of Soils,
W87-09594 8G

RESOURCE RECOVERY

Anaerobic Treatment of Distillery Slops Using an Upflow Anaerobic Filter Reactor,
W87-08890 5D

RESOURCES DEVELOPMENT

Interactive Computer-Aided Water Resources and Environmental Planning Using Color Raster Graphics: Program Description and User's Guide,
W87-09426 7C

RESOURCES MANAGEMENT

State of the Environment, 1985.
W87-09336 6G

RESPIRATION

Water Vapor Uptake and Photosynthesis of Lichens: Performance Differences in Species with Green and Blue-Green Algae as Phycobionts,
W87-09345 2I

Effects of Water Stress on Gas Exchange and Water Relations of Succulent Epiphyte, Kalanchoe Uniflora,
W87-09347 2I

RESUSPENSION

Resuspension in the Shallow Sublittoral Zone of a Macrotidal Estuarine Environment: Wind Influence,
W87-08933 2L

RETENTION

Applications of Porous Membranes for Biomass Retention in Biological Wastewater Treatment Processes,
W87-08889 5D

RETENTION CAPACITY

Influence of Long Term Cultural Operations on Physical and Water Retention Characters of a Red Sandy Loam Soil,
W87-08773 2G

REVERSED PHASE CHROMATOGRAPHY

Chromatographic Studies of Dissolved Organic Matter and Copper-Organic Complexes Isolated From Estuarine Waters,
W87-08960 7B

REVETMENTS

Defending Our LakeShores,
W87-08674 4D

Model of Stability of Revetments of Earth Spillway Slopes,
W87-09357 8D

REVIEWS

Water Use of Eucalypts - A Review with Special Reference to South India,
W87-08749 6G

Benthic Macroinvertebrates of the Meuse River in Belgium: A Review of Five Years of Research (1980-1984) (Les Macroinvertebres Benthiques de la Meuse Belge: Bilan de Cinq Annees de Recherches (1980 a 1984),
W87-08765 5C

Agricultural Drainage Practices in Ireland,
W87-09202 4A

Groundwater Management in France,
W87-09205 2F

Wetlands Policy Crisis: United States and United Kingdom,
W87-09215 6E

Estimating Evapotranspiration,
W87-09469 2D

RHINE RIVER

Research in Environmental Pollution: II. Determination of Polychlorinated Nitrobenzenes (PCNB's) in Main River Fish,
W87-08895 5A

Removal of Iron and Manganese by Ozone during Drinking Water Treatment in Dusseldorf,
W87-09136 5F

RHODE ISLAND

Ecological Factors in the Selection of Representative Species for Thermal Effluent Demonstrations,
W87-09315 5C

RICE

Changes at Panicle Emergence in the Water Relations of a Wetland and a Dryland Japonica Rice Cultivar Under Wetland Conditions,
W87-09415 2I

RICHARDS' EQUATION

Quasi-Solution of Richards' Equation for the Downward Infiltration of Water into Soil,
W87-09019 2G

RIJEKA BAY

Chlorinated Insecticides and PCBs in Asteroidea and Holothuroidea Species from Rijeka Bay, Yugoslavia,
W87-08724 5B

RIPARIAN LAND

Riparian Areas as Filters for Agricultural Sediment,
W87-09002 4A

RISK ASSESSMENT

Environmental Exposure from Chemicals.
W87-08675 5B

Chemical Safety Evaluation,
W87-09301 5B

RISKS

Overtopping Risk for an Existing Dam,
W87-09461 8A

RIVER BEDS

Physical and Biological Effects of Gravel Extraction in River Beds,
W87-09049 4C

RIVER FLOW

Nature of Organic Matter in Rivers with Deep Sea Connections: The Ganges-Brahmaputra and Indus,
W87-08721 2H

Transformation of Input to a Stochastic Model Using a Distribution Deterministic Model,
W87-08825 2E

River Flow with Excessive Suspended Sediment Load: An Evaluation of Turbulent Flow Characteristics,
W87-08826 2E

RIVER NIGER

Chemistry of the River Niger I. Major Ions,
W87-08719 2K

Chemistry of the River Niger II. Trace Metals,
W87-08720 2K

RIVER TEES

Effects of Impoundment and Regulation of the River Tees at Cow Green (Northern Pennines, UK) Upon Fish Populations in Afferent Tributaries and in the River Immediately Downstream of the Dam,
W87-09040 6G

RIVERS

Effects of an Acidic River, Caused by Acidic Rain, on Weight Gain, Steroidogenesis, and Reproduction in the Atlantic Salmon (Salmo salar),
W87-08651 5C

Modeling Chemical Transport in Lakes, Rivers, and Estuarine Systems,
W87-08672 5B

Ecological and Statistical Prognosis of the Dynamics of Fish Catch Based on Dendrochronological Data,
W87-08711 2H

Water-Quality Trends in the Nation's Rivers,
W87-08779 5G

Determination of Trace Metals in a River Water Reference Material by Inductively Coupled Plasma Mass Spectrometry,
W87-08832 5A

Organochlorine Pesticide Residues in Fish from the Shatt al-Arab River, Iraq,
W87-08880 5B

Residues of Organochlorine Pesticides in Environmental Samples from the Shatt-al-Arab River, Iraq,
W87-08910 5B

Regulation of Riverine Fish Communities by a Continuum of Abiotic-Biotic Factors,
W87-09037 2H

Dredging of Rapids for Timber-Floating in Finland and Its Effects on River-Spawning Fish Stocks,
W87-09045 6G

Restoration of the River Vaikkojoki, Finland,
W87-09046 2H

Review of Brown Trout (Salmo trutta) Spawning Beds, Indicating Methods for their Re-establishment in Danish Lowland Rivers,
W87-09047 2H

Dependence of River Pollution on Streamflow Regulation by Reservoirs,
W87-09361 5G

Laboratory and Instream Nitrification Rates for Selected Streams,
W87-09378 2H

Winter Flow, Ice, and Weather Conditions of the Upper St. Lawrence River, 1971-81; Volume I: Ice Cover Charts (Part A),
W87-09475 2E

ROCKFILL DAMS
Sri Lanka's Randenigala Project,
W87-09412 8A

ROCKS
Conditions for Crack Propagation by Frost Wedging,
W87-09350 2C

ROMAN DAMS
Roman Dams in Southern Portugal,
W87-09411 6E

ROMANIA
Effects on Fisheries of Non-Biotic Modifications of the Environment in the East-Danube River Area,
W87-09038 6G

ROOTS
Spring Wheat Growth at High and Low Soil Water with Constricted Upper Roots,
W87-08893 2D

RUNOFF
Laboratory Experiment on the Role of Grass for Infiltration and Runoff Processes,
W87-08622 2A

Groundwater Recharge and Discharge Response to Rainfall on a Hillslope,
W87-08706 2F

Soil Water Balance Model for Sloping Land,
W87-08735 2A

Linear Regression Model Combined with a Soil Water Balance Model to Design Micro-Catchments for Water Harvesting in Arid Zones,
W87-08738 3B

Runoff Studies in a Small Catchment,
W87-08822 2E

WATBAL: A Semi-Distributed, Physically Based Hydrological Modelling System,
W87-08823 2G

Transport of Solids in Streamflow from Coastal Plain Watersheds,
W87-08924 2J

Water Quality Beneath Urban Runoff Water Management Basins,
W87-08967 2F

Steady-State Analysis of Infiltration and Overland Flow for Spatially-Varied Hillslopes,
W87-08974 2E

Semiportable Multislot Divisor for Erosion and Runoff Measurements,
W87-09010 7B

Stochastic Model for Sediment Yield Using the Principle of Maximum Entropy,
W87-09016 2J

RUNOFF FORECASTING
Runoff Studies in a Small Catchment,
W87-08822 2E

WATBAL: A Semi-Distributed, Physically Based Hydrological Modelling System,
W87-08823 2G

Operational Spring Time Forecasting Difficulties and Improvements,
W87-08824 2E

Urban Stormwater Hydrology.
W87-09096 4C

Rainfall for Urban Stormwater Design,
W87-09098 2B

RUNOFF RATES
Rainfall Abstractions,
W87-09099 2A

RURAL AREAS
Knowledge Attitudes and Practices in Relation to Schistosomiasis in a Rural Community,
W87-08778 5F

SAFE DRINKING WATER ACT
Regulatory Flexibility and Consumer Options Under the Safe Drinking Water Act,
W87-09131 5F

SAFETY
Development of a Ground Water Hazard Map for an Underground Coal Mine,
W87-09585 2F

SALINE-FRESHWATER INTERFACES
Impact of the Dupuit-Forchheimer Approximation on Salt-Water Intrusion Simulation,
W87-08758 2F

SALINE LAKES
Surface Manifestations of Internal Oscillations in a Highly Saline Lake (the Dead Sea),
W87-08866 2H

SALINE SOILS
Volatilization Loss of Nitrogen from Submerged Saline Soil,
W87-08892 2G

SALINE WATER
Improvement of Irrigation Water by Gypsum Beds,
W87-08745 5G

Perennial Pasture Production after Irrigation with Saline Groundwater in the Goulburn Valley, Victoria,
W87-09208 3C

Study of Saline Water Use at the Harry Allen Generating Station,
W87-09332 3C

SALINE WATER INTRUSION
Impact of the Dupuit-Forchheimer Approximation on Salt-Water Intrusion Simulation,
W87-08758 2F

Mathematical Study of the Impact on Salinity Intrusion of Deepening the Lower Mississippi River Navigation Channel,
W87-09095 5B

Low Freshwater Inflow Study: Chesapeake Bay Hydraulic Model Investigation,
W87-09484 2L

Protection of the Karstic Springs System in Golubinka Against Contamination by the Sea Water (la Protection du Systeme des Sources Karstiques de Golubinka Contre la Contamination par la Mer),
W87-09582 4B

SALINITY
Ecological and Physiological Differentiation Among Low-Arctic Clones of Daphnia Pulex,
W87-08691 2H

Proposals for Agricultural Development of Wadi Dhuleil Catchment, Jordan,
W87-08739 3F

Salinity During Embryonic Development Influences the Response to Salinity of Gasterosteus Aculeatus L. (Trachurus),
W87-08793 2H

Perennial Pasture Production after Irrigation with Saline Groundwater in the Goulburn Valley, Victoria,
W87-09208 3C

Induction of Crassulacean Acid Metabolism in Mesembryanthemum crystallinum by High Salinity: Mass Increase and de Novo Synthesis of PEP-Carboxylase,
W87-09418 3C

Dispersal-Mediated Coexistence of Mud Snails (Hydrobiidae) in an Estuary,
W87-09422 2L

SALIX
Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XII. Growth, Photosynthetic Capacity and Metal Ion Uptake in Salix caprea and S. Cinerea ssp. Oleifolia,
W87-09399 2I

Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XIII. The Effect of Fe(2+) on Photosynthesis and Respiration of Salix caprea and S. cinerea ssp. oleifolia,
W87-09400 2I

SALMON
Effects of an Acidic River, Caused by Acidic Rain, on Weight Gain, Steroidogenesis, and Reproduction in the Atlantic Salmon (Salmo salar),
W87-08651 5C

Effects of Suspended Volcanic Ash and Thermal Shock on Susceptibility of Juvenile Salmonids to Disease,
W87-08653 5C

Comparison of Parasite Fauna of Juvenile Sockeye Salmon (Oncorhynchus Nerka) from Southern British Columbian and Washington State Lakes,
W87-08792 2H

Cadmium and Lead in Lake Ontario Salmonids,
W87-08883 2H

Effects on Salmonid Populations of Isolation of a Lake From a River System,
W87-09051 6G

Assessment of the Flow Requirements for Upstream Migration of Salmonids in Some Rivers of North-West England,
W87-09058 2H

Natural Propagation and Habitat Improvement - Washington, Volume IIA - Tumwater Falls and Dryden Dam Fish Passage.
W87-09109 8I

SALMONELLAE
Multiyear Study of Sludge Application to Farmland: Prevalence of Bacterial Enteric Pathogens and Antibody Status of Farm Families,
W87-09394 5C

SALT MARSHES
Predation Risk and Use of Intertidal Habitats by Young Fishes and Shrimp,
W87-08787 2L

Digestion of Carbohydrates and Protein by Gammarus mucronatus Say (Amphipoda),
W87-08839 2L

Sedimentation and Bioturbation in a Salt Marsh as Revealed by 210Pb, 137Cs, and 7Be Studies,
W87-08932 2L

Distribution and Abundance of Helice tridens (De Haan) Burrows and Substratum Conditions in a Northeastern Japan Salt Marsh (Crustacea: Brachyura),
W87-08987 2L

Systematics and Ecology of Lyngbya spp. and Associated Species (Cyanophyta) in a New England Salt Marsh,
W87-09423 2L

Examination of Tidal Flats, Vol. 1: Research Report.
W87-09492 4C

Ten Years of Saltmarsh Monitoring - The Case History of a Southampton Water Saltmarsh and a Changing Refinery Effluent Discharge,
W87-09545 5C

Effects of Oil Spill Cleanup Techniques on a Salt Marsh,
W87-09548 5C

Impact of the Esso Bayway Oil Spill on Salt Marsh Macro Fauna,
W87-09550 5C

SALT TOLERANCE

Irrigation with Brackish Water under Desert Conditions: IV. Salt Tolerance Studies with Lettuce (Lactuca sativa L.),
W87-08746 3C

Irrigation with Brackish Water under Desert Conditions: V. Nitrogen Requirement of Tomatoes (Lycopersicon esculentum Mill.) during Germination under Drip Irrigation,
W87-08747 3C

Salinity During Embryonic Development Influences the Response to Salinity of Gasterosteus Aculeatus L. (Trachurus),
W87-08793 2H

Hormonal Regulation of Protein Synthesis Associated With Salt Tolerance in Plant Cells,
W87-09227 2I

Induction of Crassulacean Acid Metabolism in Mesembryanthemum crystallinum by High Salinity: Mass Increase and de Novo Synthesis of PEP-Carboxylase,
W87-09418 3C

SALVAGE

Coast Guard Environmental Mission Fulfilled by Naval Salvage, French Frigate Shoals,
W87-09530 5G

SAMPLE PREPARATION

Determination of Cobalt, Copper, Mercury, and Nickel as Bis(2-hydroxyethyl)dithiocarbamate Complexes by High-Performance Liquid Chromatography,
W87-08831 5A

Spectrophotometric Determination of Traces of Silicon in Water after Collection as Silicomolybdenum Blue on an Organic-Solvent-Soluble Membrane Filter,
W87-08833 5A

Analysis of Pentachlorophenol in Water and Urine by Enrichment with Lipidex(R) 5000,
W87-08896 5A

Concentration of Giardia Cysts from Water by a Centrifugal Cream Separator,
W87-09209 5A

Quantification of PCB by Dechlorination to Biphenyl,
W87-09259 5A

Gas-Chromatographic Determination of Total Polychlorinated Aromates and Chloro-Paraffins Following Catalytic Reduction in the Injection Port,
W87-09260 5A

On-Line Sulphate Monitoring by Reversed Flow Injection Analysis and Alternating Reagent Injection,
W87-09261 5A

SAMPLE PRESERVATION

Effect of Storage on the Distribution of Trace Elements (Lead, Cadmium, Copper, Zinc and Mercury) in Natural Water,
W87-08914 5A

SAMPLERS

Digital Controller for Discrete Stage Activation of Automatic Pumping Samplers,
W87-08983 7B

SAMPLING

Monitoring Well Installation, Purging, and Sampling Techniques - Part 1: Conceptualizations,
W87-08755 7B

Statistical Assessment of a Sampling Pattern for Evaluation of Changes in Mercury and Zinc Concentrations in Patella coerulea,
W87-08884 5A

Guidelines for Sampling and Analyzing Solutions from Aquifer Thermal-Energy-Storage Systems,
W87-09457 5A

SAMPLING DEVICES

Two New Ground-Level Cloud Water Sampler Designs Which Reduce Rain Contamination,
W87-08948 7B

Digital Controller for Discrete Stage Activation of Automatic Pumping Samplers,
W87-08983 7B

Attempt to Measure the Flow of Chlorinated Hydrocarbons, such as PCBs, from Water to Air in the Field,
W87-09246 7B

SAMPLING METHODS

Sampling and Composition of the Surface Microlayer,
W87-09173 5A

SAN FRANCISCO BAY

Copper in Marine Microlayers: Accumulation, Speciation and Transport,
W87-09172 5B

SAND

Vacuum Trough Extractors for Measuring Drainage and Nitrate Flux Through Sandy Soils,
W87-08989 7B

SAND FILTERS

Importance of Laboratory Scale Study for the Design of Mobile-Bed Filter,
W87-09442 5F

SAND FILTRATION

Removal of Individual Off-Flavour Compounds in Water During Artificial Groundwater Recharge and During Treatment by Alum Coagulation/Sand Filtration,
W87-09267 5F

SANITATION

Knowledge Attitudes and Practices in Relation to Schistosomiasis in a Rural Community,
W87-08778 5F

Applied Stream Sanitation,
W87-09189 2H

SATELLITE TECHNOLOGY

Relative Accuracy of Satellite and Raingage Rainfall Measurements over Middle Latitudes during Daylight Hours,
W87-08700 2B

Remote Sensing: Principles and Interpretation,
W87-09065 7B

SATURATED FLOW

Determination of Hydraulic Conductivity from Auger Holes and Pits - An Approximation,
W87-08617 2F

Finite Element Analysis of Water Flow in Variably Saturated Soil,
W87-08620 2G

SAVANNAH RIVER

Establishment of Biotic Communities Within a Newly Constructed Ash Settling Basin and Its Drainage System,
W87-09323 5E

SCALE

Interaction of Euonymus scale (Homoptera:Diaspididae) Feeding Damage and Severe Water Stress on Leaff Abscission and Growth of Euonymus Fortunei,
W87-09344 2I

SCALE EFFECT

Scale-Up of Water and Wastewater Treatment Processes.
W87-09431 5D

Scale-Up and Scale-Down Concepts and Problems,
W87-09432 5D

Introduction to Scale-Up of Water and Wastewater Treatment Processes,
W87-09433 5D

Perspectives on the Scale-Up of Impeller Mixers,
W87-09434 5D

Important Issues in the Scale Up of New Processes,
W87-09435 5D

Geometric Parameters and Efficiency of Diffused Air Systems,
W87-09437 5D

Significance of Oxygen Transfer Variables in the Sizing of Dome Diffuser Aeration Equipment,
W87-09438 5D

Optimization of Mechanical Aerators in a Hydraulic Two-Phase Flow Model and the Scale-Up of the Results for the Prototype,
W87-09439 5D

Factors of Scale in Rapid Sand Filtration,
W87-09440 5F

Scaling-Up Studies on Wastewater Sedimentation,
W87-09441 5D

Importance of Laboratory Scale Study for the Design of Mobile-Bed Filter,
W87-09442 5F

Unique Pre-Ozonation - D.E. Filtration Water Treatment Plant Design is Based on Pilot Plant Data,
W87-09443 5F

Development of a New Type of Fluidized Bed Reactor,
W87-09444 5D

Modeling for Process Scale-Up of Adsorption and Ion Exchange Systems,
W87-09446 5D

Scale-Up of Direct Filtration (The Wahnbach System),
W87-09447 5F

Scale-Up of a Radium-226 Removal Process,
W87-09448 5D

Relationship Between Bench Scale and Prototype Activated Sludge Systems,
W87-09449 5D

Role of Kinetic Models for the Scale-Up of Biological Processes,
W87-09450 5D

SCALE EFFECT

Scale-Up of Activated Sludge and Trickling Filter Processes,
W87-09451 5D

Scale-Up of Biological Wastewater Treatment Processes: Practical Experiences in the U.K.,
W87-09453 5D

Development of a Competitive Two-Stage Biological Treatment System: Results of Pilot Plants and Full Scale Plants,
W87-09454 5D

Scale-Up Experience with the Waterloo SCP Process in Industrial Biomass Waste Treatment,
W87-09455 5D

SCALE EFFECTS

Ecohydrodynamics and Simulation: Some Relevant Problems of Scale-Up and -Down,
W87-09436 5C

SCALE-UP

Scale-Up of Solid Bowl Centrifuges for Sludge Dewatering,
W87-09445 5E

SCAVENGING

Scavenging of Atmospheric Sulfate by Arctic Snow,
W87-08947 2C

SCHISTOSOMIASIS

Knowledge Attitudes and Practices in Relation to Schistosomiasis in a Rural Community,
W87-08778 5F

SCOTLAND

Composition of Suspended Particulate Matter from Scottish Coastal Waters Geochemical Implications for the Transport of Trace Metal Contaminants,
W87-08729 5B

Supply of Snow in the Eastern Highlands of Scotland: 1954-5 to 1983-4,
W87-08810 2C

Spatial Variability in the Chemical Composition of Snowcover in a Small, Remote, Scottish Catchment,
W87-08945 5B

SCREENS

Fish Diversion in Hydropower Intake,
W87-09197 8I

SEA ICE

Determination of the Ice Load on Elements of Marine Hydraulic Structures,
W87-09359 8A

Dome's Petroleum Study of Oil and Gas Under Sea Ice,
W87-09525 5G

SEA WALLS

Kahului Breakwater Stability Study, Kahului, Maui, Hawaii: Hydraulic Model Investigation,
W87-09488 8B

SEASONAL VARIATION

Seasonal Variation of Copper and Zinc Concentrations in the Oyster Saccostrea cuccullata from the Dampier Archipelago, Western Australia: Implications for Pollution Monitoring,
W87-08732 5B

Seasonality of Blue Mussel, Mytilus edulis L., Larvae in the Damariscotta River Estuary, Maine, 1969-77,
W87-08849 2L

Structure and Dynamics of Internal Waves in Baldeggersee,
W87-08864 2H

Surface Manifestations of Internal Oscillations in a Highly Saline Lake (the Dead Sea),
W87-08866 2H

Mathematical Model of Seasonal and Spatial Variation in Phosphorus Concentrations in Lake Memphremagog, Quebec,
W87-08899 5B

Seasonality of Legionella Isolates from Environmental Sources,
W87-08902 2H

Seasonal Distribution of Legionellae Isolated from Various Types of Water in Israel,
W87-08903 5A

Water Vapor Transport Over the Indian Ocean During the 1979 Summer Monsoon. Part I: Water Vapor Fluxes,
W87-08937 2B

Influence of Soil Characteristics and Environmental Conditions on Seasonal Variations of Water-Soluble Phosphate in Soils,
W87-09257 2G

Data Intercomparison Theory I. Minimal Spanning Tree Tests for Location and Scale Differences,
W87-09501 7C

SEAWATER

Stagnant Sulphidic Basin Waters,
W87-08722 2K

Geochemistry of Humic Substances in Seawater,
W87-09075 2L

Theory of Fluorescent Irradiance Fields in Lakes and Seas,
W87-09193 5A

Suppression of Phosphate Liberation from Sediment by Using Iron Slag,
W87-09273 5G

Spill Impacts and Shoreline Cleanup Operations on Arctic and Sub-Arctic Coasts,
W87-09538 5G

Problems of Water Inrush into Greek Underground Mines with Special Emphasis to Sea Water Inrush Through Karstic Limestones or Impermeable Formations,
W87-09596 2F

SECONDARY CURRENTS

Lateral Mixing in Channels Due to Secondary Currents,
W87-08827 2E

SECONDARY PRODUCTIVITY

Theory of Secondary Production Calculations for Continuously Reproducing Populations,
W87-08862 2L

SECONDARY WASTEWATER TREATMENT

Puerto Rico Seeks Clean Water,
W87-08802 5D

SEDIMENT CONTROL

Erosion and Sediment Control Handbook,
W87-08686 4D

SEDIMENT LOAD

River Flow with Excessive Suspended Sediment Load: An Evaluation of Turbulent Flow Characteristics,
W87-08826 2E

Economic Differences Between Cumulative and Episodic Reduction of Sediment from Cropland,
W87-09090 2J

SEDIMENT TRANSPORT

Fluvial Hydrology,
W87-08685 2A

Analysis of Horizontally Two-Dimensional Morphological Evolutions in Shallow Water,
W87-08782 7C

River Flow with Excessive Suspended Sediment Load: An Evaluation of Turbulent Flow Characteristics,
W87-08826 2E

Transport of Solids in Streamflow from Coastal Plain Watersheds,
W87-08924 2J

Mechanics of Sediment Transportation and Alluvial Stream Problems,
W87-09337 2J

Sediment Diffusion in Primary Shallow Rectangular Clarifiers,
W87-09376 5F

Suspended Particulate Matter in Commencement Bay,
W87-09498 2J

Plans and Experiments to Deal with Large Amounts of Sediment in Hungarian Mines under Karstic Water Hazard,
W87-09590 4C

SEDIMENT-WATER INTERFACES

Dynamics of Bottom Currents in a Small Lake,
W87-08865 2H

SEDIMENT YIELD

Stochastic Model for Sediment Yield Using the Principle of Maximum Entropy,
W87-09016 2J

SEDIMENTATION

Macrofossil and Pollen Representation of Coniferous Trees In Modern Sediments from Washington,
W87-08690 2H

Analysis of Horizontally Two-Dimensional Morphological Evolutions in Shallow Water,
W87-08782 7C

Predicting Settlement at a Damsite on a Tunnel Valley Deposit in Alberta,
W87-08795 8A

Vertical Transport of Heavy Metals by Settling Particles in Lake Zurich,
W87-08869 5B

Sedimentation and Bioturbation in a Salt Marsh as Revealed by 210Pb, 137Cs, and 7Be Studies,
W87-08932 2L

Sedimentation in Lake Onalaska, Navigation Pool 7, Upper Mississippi River, Since Impoundment,
W87-08969 2J

Downward Movement of Partly Degraded Materials in Dyked Marsh Soils,
W87-08998 2H

Economic Differences Between Cumulative and Episodic Reduction of Sediment from Cropland,
W87-09090 2J

Scaling-Up Studies on Wastewater Sedimentation,
W87-09441 5D

SEDIMENTS

Geochemical Partitioning of Heavy Metals in Sediments of Three Estuaries Along the Coast of Rio de Janeiro (Brazil),
W87-08717 2L

Heavy Metal Pollution in the Paraiba do Sul River, Brazil,
W87-08718 5B

Nature of Organic Matter in Rivers with Deep Sea Connections: The Ganges-Brahmaputra and Indus,
W87-08721 2H

Complete HF Digestion Method for Element and Trace Element Determination in Soils, Sediments, Sludges and Other Similar Samples Using a Closed System (HF-Totalaufschluss im geschlossenen System fur Element- und Spurenelementbestimmungen in Boden, Klarschlamm, Sedimenten u. a. Proben),
W87-08894 5A

Asbestos Fibres Introduce Trace Metals into Streamwater and Sediments,
W87-08912 5B

Thymidine Incorporation and Microbial Respiration in the Surface Sediment of a Hypereutrophic Lake,
W87-08936 2H

Accuracy of Selective Extraction Procedures for Metal Speciation in Model Aquatic Sediments,
W87-08985 5A

Slope Gradient Effect on Erosion of Reshaped Spoil,
W87-09000 2J

Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization.
W87-09067 2H

Geochemistry of Humin,
W87-09077 2H

Heavy Metals Distribution in the Sediments of Ganges and Brahmaputra Rivers,
W87-09204 5B

New Method for Determining the Concentrations of Volatile Organic Compounds in Sediment Interstitial Water,
W87-09233 5A

Suppression of Phosphate Liberation from Sediment by Using Iron Slag,
W87-09273 5G

Distribution of Particulate Matter in Relation to the Thermal Cycle in Lake Vechten (The Netherlands): The Significance of Transportation Along the Bottom,
W87-09275 2H

Mechanics of Sediment Transportation and Alluvial Stream Problems,
W87-09337 2J

Simultaneous Determination of Linear Alkylbenzenesulfonates, Alkylphenol Polyethoxylates, and Nonylphenol by High-Performance Liquid Chromatography,
W87-09343 5A

Distribution of Protozoa in Subsurface Sediments of a Pristine Groundwater Study Site in Oklahoma,
W87-09395 2H

Field Survey of Heavy Metal Uptake by Naturally Occurring Saltwater and Freshwater Marsh Plants,
W87-09490 5B

Suspended Particulate Matter in Commencement Bay,
W87-09498 2J

Fate and Effects of Dispersant-Treated Compared with Untreated Crude Oil, with Particular Reference to Sheltered Intertidal Sediments,
W87-09537 5G

SEEPAGE

Detection of Defects in a Grout Curtain by Geophysical Methods,
W87-09358 8E

Seepage Regime in the Foundation of the Kanev Hydroelectric Station,
W87-09364 8D

SEICHES

Internal Waves of the Second Vertical Mode in a Stratified Lake,
W87-08863 2H

Structure and Dynamics of Internal Waves in Baldeggersee,
W87-08864 2H

Surface Manifestations of Internal Oscillations in a Highly Saline Lake (the Dead Sea),
W87-08866 2H

SEIONT RIVER

Effects on Salmonid Populations of Isolation of a Lake From a River System,
W87-09051 6G

SEISMIC SHEAR

2-D Elastoplastic Seismic Shear Response of Earth Dams: Theory,
W87-08607 8A

2-D Elastoplastic Seismic Shear Response of Earth Dams: Applications,
W87-08608 8A

SELENASTRUM

Hexavalent Chromium Effects on Carbon Assimilation in Selenastrum capricornutum,
W87-08886 5C

SELENIUM

Geochemistry, Soils and Cardiovascular Diseases,
W87-08692 2F

Epidemiology of Dental Caries in Relation to Environmental Trace Elements,
W87-08694 5C

Selenium in the Tributaries of the Orinoco in Venezuela,
W87-09406 2K

SEMIARID LANDS

Semiarid Soil and Water Conservation,
W87-08661 3F

Soil Erosion Process,
W87-08663 2J

SEMIARID REGIONS

Use of Topological Information in Hydrograph Estimation,
W87-08976 2E

SENSITIVITY ANALYSIS

Sensitivity of Chronic Endpoints Used in Daphnia Magna Straus Life-Cycle Tests,
W87-08642 5C

SENSORS

Pulsed Nuclear Magnetic Resonance Instrument for Soil-Water Content Measurement: Sensor Configurations,
W87-08991 7B

SEPTIC TANKS

Septic Tank System Effects on Ground Water Quality,
W87-09310 5C

Wastewater-Induced Soil Clogging Development,
W87-09373 5C

SESTON

Sestonic Bacteria as a Food Source for Filtering Invertebrates in Two Southeastern Blackwater Rivers,
W87-08870 2H

SETTLING BASINS

Establishment of Biotic Communities Within a Newly Constructed Ash Settling Basin and Its Drainage System,
W87-09323 5E

SETTLING TANKS

Scaling-Up Studies on Wastewater Sedimentation,
W87-09441 5D

SETTLING VELOCITY

Stroboscopic Determination of Settling Velocity, Size and Porosity of Activated Sludge Flocs,
W87-09263 7B

Sediment Diffusion in Primary Shallow Rectangular Clarifiers,
W87-09376 5F

SEWERS

Design and Use of Pressure Sewer Systems,
W87-09309 5D

SHALLOW WATER

Analysis of Horizontally Two-Dimensional Morphological Evolutions in Shallow Water,
W87-08782 7C

SHEAR RESPONSE

2-D Elastoplastic Seismic Shear Response of Earth Dams: Theory,
W87-08607 8A

2-D Elastoplastic Seismic Shear Response of Earth Dams: Applications,
W87-08608 8A

SHEARING

Biofilm Shearing Under Dynamic Conditions,
W87-09367 5D

SHELLFISH FARMING

Cadmium Contamination in American Lobster, Homarus americanus, Near a Coastal Lead Smelter: Use of Multiple Linear Regression for Management,
W87-08882 5C

SHORE PROTECTION

Counting the Days Along Lake Michigan,
W87-08804 2J

SHRIMP

Field Confirmation of a Laboratory-Derived Hazard Assessment of the Acute Toxicity of Fenthion to Pink Shrimp, Penaeus duorarum,
W87-08638 5C

Predation Risk and Use of Intertidal Habitats by Young Fishes and Shrimp,
W87-08787 2L

Comparative Metabolism of Fenitrothion in Aquatic Organisms: III. Metabolism in the Crustaceans, Daphnia pulex and Palaemon paucidens,
W87-08861 5B

Residues of Organochlorine Pesticides in Environmental Samples from the Shatt-al-Arab River, Iraq,
W87-08910 5B

Immunological Dietary Analysis of Two Penaeid Shrimp Species from a South Carolina Tidal Creek,
W87-08988 2L

Introduction of Mysis relicta in Sweden: Effects on Fish in Impounded Lakes,
W87-09057 2H

Fish Predation on Juvenile Brown Shrimp, Penaeus Aztecus Ives: Effects of Turbidity and Substratum on Predation Rates,
W87-09252 2H

SIAMOS
Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I and II.
W87-09568 2F

SIDEROPHORES
Induction of Siderophore Activity in Anabaena spp. and Its Moderation of Copper Toxicity,
W87-09386 5G

SIERRA NEVADA
SCPP Meteorological and Statistical Support for Period 1 September 1985, 31 August 1986, Volume I: Interim Progress Report,
W87-09334 2B

SILICA-FUME CONCRETE
Use of Silica-Fume Concrete to Repair a Stilling Basin,
W87-09413 8F

SILICOMOLYBDENUM BLUE
Spectrophotometric Determination of Traces of Silicon in Water after Collection as Silicomolybdenum Blue on an Organic-Solvent-Soluble Membrane Filter,
W87-08833 5A

SILICON
Spectrophotometric Determination of Traces of Silicon in Water after Collection as Silicomolybdenum Blue on an Organic-Solvent-Soluble Membrane Filter,
W87-08833 5A

SIMOJOKI RIVER
Dredging of Rapids for Timber-Floating in Finland and Its Effects on River-Spawning Fish Stocks,
W87-09045 6G

SIMULATED RAINFALL
Impact of Simulated Acidic Precipitation on Quantity and Quality of a Field Grown Potato Crop,
W87-08789 5C

Effect of Tillage System on Runoff Losses of Surface-Applied Pesticides,
W87-09001 2E

Rainfall for Urban Stormwater Design,
W87-09098 2B

Influence of Simulated Acidic Rain on Vegetative and Reproductive Tissues of Cucumber (Cucumis sativus L.),
W87-09232 5C

Effects of Simulated Acidic Mist on Germination of Alternaria solani and Phytophthora infestans in vitro and their Infection Efficiency and Sporulation on Potato,
W87-09414 5C

Yield Reductions in Winter Barley Grown on a Range of Soils and Exposed to Simulated Acid Rain,
W87-09416 5C

SIMULATION
Review of Methods of Parameter Estimation for the Extreme Value Type-1 Distribution,
W87-08619 7C

Soil Water Balance Model for Sloping Land,
W87-08735 2A

Impact of the Dupuit-Forchheimer Approximation on Salt-Water Intrusion Simulation,
W87-08758 2F

Modelling of Unsaturated Flow in Heterogeneous Soils Part I: Deterministic Simulations of Water Flow in Soil Profiles,
W87-08816 2G

Synthesis of a Simplified Water Use Simulation Model for Predicting Wheat Yields,
W87-09028 2I

Comprehensive Model for Oil Spill Simulation,
W87-09552 5B

SIMULATION ANALYSIS
Simulation Model for Predicting Effect of Water Stress on Yield: An Example Using Corn,
W87-09470 3F

SITE SELECTION
Geologic Isolation of High-Level Radioactive Waste: Putting It Away Forever,
W87-08805 5E

SKIING
Supply of Snow in the Eastern Highlands of Scotland: 1954-5 to 1983-4,
W87-08810 2C

SLIP EROSION
Effect of Soil Slip Erosion on Wairoa Hill Pasture Production and Composition,
W87-08734 2J

SLOPE DEGRADATION
Effect of Soil Slip Erosion on Wairoa Hill Pasture Production and Composition,
W87-08734 2J

SLOPE GRADIENT
Slope Gradient Effect on Erosion of Reshaped Spoil,
W87-09000 2J

SLOPE STABILITY
Considertion of the Stress-Strain State in Calculations of Slope Stability of Earth Dams,
W87-09356 8D

Model of Stability of Revetments of Earth Spillway Slopes,
W87-09357 8D

SLOPES
Soil Water Balance Model for Sloping Land,
W87-08735 2A

Steady-State Analysis of Infiltration and Overland Flow for Spatially-Varied Hillslopes,
W87-08974 2E

SLUDGE
Recovery of Organics from Tailings Pond Sludge Using Coke for Agglomeration,
W87-08602 5D

Complete HF Digestion Method for Element and Trace Element Determination in Soils, Sediments, Sludges and Other Similar Samples Using a Closed System (HF-Totalaufschluss im geschlossenen System fur Element- und Spurenelementbestimmungen in Boden, Klarschlamm, Sedimenten u. a. Proben),
W87-08894 5A

Effects of pH and Soil Type on Concentrations of Zinc, Copper and Nickel Extracted by Calcium Chloride from Sewage Sludge-Treated Soils,
W87-08911 5B

'Spray-Column' Laboratory Apparatus for Organic Matter Extraction from Sludges,
W87-08913 5A

Physical and Chemical Behavior and Environmental Acceptability of Stabilized Scrubber Sludge and Fly Ash in Seawater,
W87-09327 5B

Simultaneous Determination of Linear Alkylbenzenesulfonates, Alkylphenol Polyethoxylates, and Nonylphenol by High-Performance Liquid Chromatography,
W87-09343 5A

SLUDGE DISPOSAL
Omaha Recycles Sludge in Agricultural Program,
W87-08808 5E

Dynamics of Nitrogen and Carbon in Soil during Papermill Sludge Decomposition,
W87-08891 5E

Trace and Nutrient Element Transfer from Sewage Sludge-Amended Soil to Crops: A Study on Brassica oleracea,
W87-08917 5B

Residual Effects of Sewage Sludge on Soybean: I. Accumulation of Heavy Metals,
W87-08921 5C

Residual Effects of Sewage Sludge on Soybean: II. Accumulation of Soil and Symbiotically Fixed Nitrogen,
W87-08922 5C

Soybean Growth and Boron Distribution in a Sandy Soil Amended with Scrubber Sludge,
W87-08927 5C

Effect of Sewage Sludge on Soil Structural Stability: Microbiological Aspects,
W87-08997 5C

Zinc, Copper and Nickel Concentrations in Soil Extracts and Crops Grown on Four Soils Treated with Metal-loaded Sewage Sludges,
W87-09244 5B

Multiyear Study of Sludge Application to Farmland: Prevalence of Bacterial Enteric Pathogens and Antibody Status of Farm Families,
W87-09394 5C

SLUDGE DRYING
Scale-Up of Solid Bowl Centrifuges for Sludge Dewatering,
W87-09445 5E

SLUDGE UTILIZATION
Omaha Recycles Sludge in Agricultural Program,
W87-08808 5E

SLURRIES
Economics of the Treatment of Dairy Cow Slurry by Anaerobic Digestion,
W87-09216 5D

SMALL WATERSHEDS
Stream Water Quality in the Coal Region of Virginia,
W87-09494 4C

SMELTERS
Analysis of the Impact of the Sudbury Smelters on Wet and Dry Deposition in Ontario,
W87-08942 5B

Zinc, Iron, Manganese, and Magnesium Accumulation in Crayfish Populations Near Copper - Nickel Smelters at Sudbury, Ontario, Canada,
W87-09243 5C

Response of Lake Sediments to Changes in Trace Metal Emission from the Smelters at Sudbury, Ontario,
W87-09245 5B

SMOOTH CORDGRASS
Establishing Smooth Cordgrass in Tidal Wetlands,
W87-08806 2I

SNAILS
Comparative Metabolism of Fenitrothion in Aquatic Organisms: II. Metabolism in the Fresh-

water Snails, Cipangopaludina japonica and Physa acuta,
W87-08860 5B

Dispersal-Mediated Coexistence of Mud Snails (Hydrobiidae) in an Estuary,
W87-09422 2L

SNAPPING TURTLES
Disposition of Low and High Environmental Concentrations of PCBs in Snapping Turtle Tissues,
W87-09234 5B

SNOW
Snow Forecasts from the Meteorlogical Office Fine-mesh Model During the Winter of 1985/86,
W87-08702 2B

Supply of Snow in the Eastern Highlands of Scotland: 1954-5 to 1983-4,
W87-08810 2C

Trace Metal and Strong Acid Composition of Rain and Snow in Northern Minnesota,
W87-09178 5B

SNOW ACCUMULATION
Supply of Snow in the Eastern Highlands of Scotland: 1954-5 to 1983-4,
W87-08810 2C

SNOW CHEMISTRY
Seasonal and Spatial Trends in South Greenland Snow Chemistry,
W87-08946 5B

SNOW COVER
Spatial Variability in the Chemical Composition of Snowcover in a Small, Remote, Scottish Catchment,
W87-08945 5B

Seasonal and Spatial Trends in South Greenland Snow Chemistry,
W87-08946 5B

SNOW SKIING
Supply of Snow in the Eastern Highlands of Scotland: 1954-5 to 1983-4,
W87-08810 2C

SNOWFALL
Numerical Simulation of the Effects of Varying Ice Crystal Nucleation Rates and Aggregation Processes on Orographic Snowfall,
W87-08697 2B

SNOWMELT
Modelling Water Exchange and Transit Times in Till Basins Using Oxygen-18,
W87-08821 2A

Effect of Polluted and Leached Snow Melt Waters on the Soil Bacterial Community--Quantitative Response,
W87-08874 5C

Influence of Meltwater on the Amount and Composition of Groundwater in Quaternary Deposits in Finland,
W87-09460 2F

SOCIAL ASPECTS
Groundwater Management in France,
W87-09205 2F

SOCIAL VALUES
Exploring Existence Value,
W87-09031 6C

Valuing Wildlife in Benefit-Cost Analyses: A Case Study Involving Endangered Species,
W87-09032 6B

Estimating the Value of Water Quality Improvements in a Recreational Demand Framework,
W87-09033 6C

Modeling the Demand for Outdoor Recreation,
W87-09034 6D

SODIUM
Effect of Exchangeable Sodium Percent on Surface Sealing,
W87-08742 4D

SOIL
Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization.
W87-09067 2H

Geochemistry of Humin,
W87-09077 2H

SOIL AMENDMENTS
Attenuation of Cd and Pb Solubility in Municipal Waste Incinerator Ash,
W87-08776 5E

Effect of Fertilization with Municipal Sludge on the Glutathione, Polyamine, and Cadmium Content of Cole Crops and Associated Loopers (Trichoplusia ni),
W87-08835 5C

Dynamics of Nitrogen and Carbon in Soil during Papermill Sludge Decomposition,
W87-08891 5E

Effects of pH and Soil Type on Concentrations of Zinc, Copper and Nickel Extracted by Calcium Chloride from Sewage Sludge-Treated Soils,
W87-08911 5B

SOIL ANALYSIS
Complete HF Digestion Method for Element and Trace Element Determination in Soils, Sediments, Sludges and Other Similar Samples Using a Closed System (HF-Totalaufschluss im geschlossenen System fur Element- und Spurenelementbestimmungen in Boden, Klarschlamm, Sedimenten u. a. Proben),
W87-08894 5A

SOIL BACTERIA
Effect of Polluted and Leached Snow Melt Waters on the Soil Bacterial Community--Quantitative Response,
W87-08874 5C

SOIL CHEMISTRY
Geochemistry of Soil Humic Substances,
W87-09068 2J

Extraction of Humic Substances from Soil,
W87-09079 7B

Fractionation of Soil Humic Substances,
W87-09081 2G

SOIL CLASSIFICATION
Carolina Bays on the Eastern Shore of Maryland: I. Soil Characterization and Classification,
W87-08999 2H

SOIL CLOGGING
Soil Clogging During Subsurface Wastewater Infiltration as Affected by Effluent Composition and Loading Rate,
W87-08928 5C

Wastewater-Induced Soil Clogging Development,
W87-09373 5C

SOIL COLUMNS
Mobility of Sludge-Borne 3,3'-Dichlorobenzidine in Soil Columns,
W87-08925 5B

Application of Soil Conditioner Solutions to Soil Columns to Increase Water Stability of Aggregates,
W87-09005 2G

SOIL CONSERVATION
Semiarid Soil and Water Conservation,
W87-08661 3F

Agronomic Measures for Soil and Water Conservation,
W87-08664 3F

Engineering Measures for Soil and Water Conservation: Terracing and Benching,
W87-08667 3F

Gulley Control,
W87-08669 3F

SOIL ENVIRONMENT
Impact-Sensitiveness of Soil Oribatid Species to the Waste Water from a Coal Distillation Plant,
W87-08898 5A

SOIL EROSION
Soil Erosion Process,
W87-08663 2J

Point Probability Distributions of Frozen Soil,
W87-08696 2C

Rainfall Kinetic Energy in Eastern Australia,
W87-08698 2B

Effect of Soil Slip Erosion on Wairoa Hill Pasture Production and Composition,
W87-08734 2J

Relationships Between Waterdrop Properties and Forces of Impact,
W87-09004 2J

Method to Estimate Soil Loss From Erosion,
W87-09007 7B

Semiportable Multislot Divisor for Erosion and Runoff Measurements,
W87-09010 7B

Stochastic Model for Sediment Yield Using the Principle of Maximum Entropy,
W87-09016 2J

SOIL FILTERS
Acid Neutralizing Capacity of Fine Soil Fractions,
W87-09180 2G

SOIL GENESIS
Carolina Bays on the Eastern Shore of Maryland: I. Soil Characterization and Classification,
W87-08999 2H

SOIL HORIZONS
Forest Soil Organic Horizon Acidification: Effects of Temperature, Time, and Solution/Soil Ratio,
W87-09009 2G

SOIL MECHANICS
Predicting Settlement at a Damsite on a Tunnel Valley Deposit in Alberta,
W87-08795 8A

BASIC Soil Mechanics,
W87-09307 8D

SOIL MOISTURE METERS
Pulsed Nuclear Magnetic Resonance Instrument for Soil-Water Content Measurement: Sensor Configurations,
W87-08991 7B

SOIL MOISTURE RETENTION
Influence of Long Term Cultural Operations on Physical and Water Retention Characters of a Red Sandy Loam Soil,
W87-08773 2G

Modelling of Unsaturated Flow in Heterogeneous Soils Part II: Stochastic Simulation of Water Flow Over a Field,
W87-08817 2G

SOIL-MOISTURE TENSION
Variation of the Subsoil Hydraulic Conductivities of Some New Zealand Soils with Changes in Water Tension,
W87-08736 2G

SOIL PHYSICAL PROPERTIES
Spatial Variability of Soil Water and Evapotranspiration,
W87-08815 2G

Laboratory Experiments on Solute Transport in Non-Homogeneous Porous Media,
W87-08819 5B

SOIL POROSITY
Physical Changes Induced by Rainfall in the Surface Layer of an Alfisol, Northern Nigeria,
W87-09214 2G

SOIL PROPERTIES
Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulfur, Micronutrients,
W87-08689 2G

Laboratory Experiments on Solute Transport in Non-Homogeneous Porous Media,
W87-08819 5B

Analysis of Volume Change in Unconfined Units of Soil,
W87-08992 2G

Forest Soil Organic Horizon Acidification: Effects of Temperature, Time, and Solution/Soil Ratio,
W87-09009 2G

Physical Changes Induced by Rainfall in the Surface Layer of an Alfisol, Northern Nigeria,
W87-09214 2G

Mineral Content of Grasses and Grasslands of the Himalayan Region: 2. Concentration of Trace and Major Elements in Grasses in Relation to Soil Properties and Climatic Factors,
W87-09256 2I

Influence of Soil Characteristics and Environmental Conditions on Seasonal Variations of Water-Soluble Phosphate in Soils,
W87-09257 2G

SOIL SEALANTS
Application of New Chemical Grouts in Strengthening and Sealing of Soils,
W87-09594 8G

Special Techniques of Ground Treatment in Mining Works (Las Tecnicas Especiales de Tratamiento del Terreno en los Trabajos de Mineria),
W87-09598 4B

SOIL SHRINKAGE
Alternative Procedure for Determining the Shrinkage Limit of Soil,
W87-09159 2G

SOIL SOLUTIONS
Mobilization of Aluminum in a Natural Soil System: Effects of Hydrologic Pathways,
W87-09024 5B

SOIL STABILIZATION
Application of Soil Conditioner Solutions to Soil Columns to Increase Water Stability of Aggregates,
W87-09005 2G

SOIL STRUCTURE
Analysis of Volume Change in Unconfined Units of Soil,
W87-08992 2G

SOIL TEMPERATURE
Temperature Modelling of Wet and Dry Desert Soils,
W87-08791 2G

SOIL TEXTURE
Carolina Bays on the Eastern Shore of Maryland: I. Soil Characterization and Classification,
W87-08999 2H

SOIL TREATMENT
Application of Soil Conditioner Solutions to Soil Columns to Increase Water Stability of Aggregates,
W87-09005 2G

SOIL TYPES
Modelling of Unsaturated Flow in Heterogeneous Soils Part I: Deterministic Simulations of Water Flow in Soil Profiles,
W87-08816 2G

Kinetics of Sulfate Adsorption and Desorption by Cecil Soil Using Miscible Displacement,
W87-08995 2G

Reduction in Hydraulic Conductivity in Relation to Clay Dispersion and Disaggregation,
W87-08996 2G

Physical Changes Induced by Rainfall in the Surface Layer of an Alfisol, Northern Nigeria,
W87-09214 2G

SOIL WATER
Estimation of Groundwater Recharge in Sandy Till with Two Different Methods Using Groundwater Level Fluctuations,
W87-08615 2F

Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulfur, Micronutrients,
W87-08689 2G

Influence of Soil Water Content on the Supply of Phosphate to Plants,
W87-08705 2I

Soil Water Balance Model for Sloping Land,
W87-08735 2A

Linear Regression Model Combined with a Soil Water Balance Model to Design Micro-Catchments for Water Harvesting in Arid Zones,
W87-08738 3B

Bare Soil Evaporation Near a Surface Point-Source Emitter,
W87-08743 2D

Influence of Long Term Cultural Operations on Physical and Water Retention Characters of a Red Sandy Loam Soil,
W87-08773 2G

Temporal Observations of Surface Soil Moisture Using A Passive Microwave Sensor,
W87-08781 2G

Temperature Modelling of Wet and Dry Desert Soils,
W87-08791 2G

Measurement of Soil Water Content Using the Combined Time-Domain Reflectometry - Thermal Conductivity Probe,
W87-08796 2G

Spatial Variability of Soil Water and Evapotranspiration,
W87-08815 2G

Modelling of Unsaturated Flow in Heterogeneous Soils Part I: Deterministic Simulations of Water Flow in Soil Profiles,
W87-08816 2G

Modelling of Unsaturated Flow in Heterogeneous Soils Part II: Stochastic Simulation of Water Flow Over a Field,
W87-08817 2G

WATBAL: A Semi-Distributed, Physically Based Hydrological Modelling System,
W87-08823 2G

Spring Wheat Growth at High and Low Soil Water with Constricted Upper Roots,
W87-08893 2D

Water Quality Beneath Urban Runoff Water Management Basins,
W87-08967 2F

Solute Transport During Absorption and Infiltration: A Comparison of Analytical Approximations,
W87-08990 7C

Pulsed Nuclear Magnetic Resonance Instrument for Soil-Water Content Measurement: Sensor Configurations,
W87-08991 7B

Analysis of Volume Change in Unconfined Units of Soil,
W87-08992 2G

Field Method for Estimating Hydraulic Conductivity and Matric Potential-Water Content Relations,
W87-08993 2G

Reduction in Hydraulic Conductivity in Relation to Clay Dispersion and Disaggregation,
W87-08996 2G

Effect of Sewage Sludge on Soil Structural Stability: Microbiological Aspects,
W87-08997 5C

Soil Water Evaporation Comparisons Among Tillage Practices in the Northern Great Plains,
W87-09006 2D

Dynamics of Sulfate Retention by Acid Forest Soils in an Acidic Deposition Environment,
W87-09008 5B

Quasi-Solution of Richards' Equation for the Downward Infiltration of Water into Soil,
W87-09019 2G

Mobilization of Aluminum in a Natural Soil System: Effects of Hydrologic Pathways,
W87-09024 5B

Robust-Resistant Spatial Analysis of Soil Water Infiltration,
W87-09029 7C

Simulation of the Hydrologic Cycle for Watersheds,
W87-09111 2A

Alternative Procedure for Determining the Shrinkage Limit of Soil,
W87-09159 2G

Modeling the Flow of Immiscible Fluids in Soils,
W87-09258 2G

SOIL WATER MOVEMENT
Finite Element Analysis of Water Flow in Variably Saturated Soil,
W87-08620 2G

Variation of the Subsoil Hydraulic Conductivities of Some New Zealand Soils with Changes in Water Tension,
W87-08736 2G

Modeling the Flow of Immiscible Fluids in Soils,
W87-09258 2G

SOIL-WATER-PLANT RELATIONSHIPS
Temperature Modelling of Wet and Dry Desert Soils,
W87-08791 2G

Spatial Variability of Soil Water and Evapotranspiration,
W87-08815 2G

Spring Wheat Growth at High and Low Soil Water with Constricted Upper Roots,
W87-08893 2D

SOIL WATER POTENTIAL
Measurement of Water Potential in Low-Level Waste Management,
W87-09456 7B

SOLAR ENERGY
Recovery of Water from Atmospheric Air in Arid Climates,
W87-08601 5F

SOLAR RADIATION
Degradation of Aniline and Chloroanilines by Sunlight and Microbes in Estuarine Water,
W87-09271 5B

SOLUBILITY
Attenuation of Cd and Pb Solubility in Municipal Waste Incinerator Ash,
W87-08776 5E

Limits of Bioaccumulation of Organic Pigments in Fish: Their Relation to the Partition Coefficient and the Solubility in Water and Octanol,
W87-08853 5B

SOLUTE POTENTIAL
Physiological Responses to Drought of Lolium perenne L.: Measurement of, and Genetic Variation in, Water Potential, Solute Potential, Elasticity and Cell Hydration,
W87-08848 2D

SOLUTE TRANSPORT
Comparison of Field and Laboratory Methods for Determining Contaminant Flow Parameters,
W87-08757 5B

Laboratory Experiments on Solute Transport in Non-Homogeneous Porous Media,
W87-08819 5B

Vertical Transport of Heavy Metals by Settling Particles in Lake Zurich,
W87-08869 5B

Volatilization Loss of Nitrogen from Submerged Saline Soil,
W87-08892 2G

Solute Transport During Absorption and Infiltration: A Comparison of Analytical Approximations,
W87-08990 7C

Heavy Metals Distribution in the Sediments of Ganges and Brahmaputra Rivers,
W87-09204 5B

SOLUTES
Laboratory Experiments on Solute Transport in Non-Homogeneous Porous Media,
W87-08819 5B

SOLVENT EXTRACTION
Removal of Traces of Pentachlorophenol from Aqueous Acidic Solutions by Solvent Extraction and Solvent Sublation,
W87-08605 5D

SOLVENT SUBLATION
Removal of Traces of Pentachlorophenol from Aqueous Acidic Solutions by Solvent Extraction and Solvent Sublation,
W87-08605 5D

SORPTION
Pollutant Sorption in Environmental Systems,
W87-08677 5B

New Method for Determining the Concentrations of Volatile Organic Compounds in Sediment Interstitial Water,
W87-09233 5A

SOUTH AFRICA
Seasonality of Legionella Isolates from Environmental Sources,
W87-08902 2H

Water Hazard in Deep Gold Mining of the Far West Witwatersrand - South Africa,
W87-09588 2F

SOUTH CAROLINA
Aerial Deposition of Organochlorines in Urban and Coastal South Carolina,
W87-09188 5B

SOUTH DAKOTA
Humic Substances in Groundwater,
W87-09070 2F

SOYBEANS
Nitrogenase Activity, Photosynthesis and Nodule Water Potential in Soyabean Plants Experiencing Water Deprivation,
W87-08798 2I

Residual Effects of Sewage Sludge on Soybean: I. Accumulation of Heavy Metals,
W87-08921 5C

Residual Effects of Sewage Sludge on Soybean: II. Accumulation of Soil and Symbiotically Fixed Nitrogen,
W87-08922 5C

Soybean Growth and Boron Distribution in a Sandy Soil Amended with Scrubber Sludge,
W87-08927 5C

SPATIAL DISTRIBUTION
Spatial Variability of Soil Water and Evapotranspiration,
W87-08815 2G

Modelling of Unsaturated Flow in Heterogeneous Soils Part II: Stochastic Simulation of Water Flow Over a Field,
W87-08817 2G

SPATIAL VARIATION
Spatial Variability in the Chemical Composition of Snowcover in a Small, Remote, Scottish Catchment,
W87-08945 5B

Seasonal and Spatial Trends in South Greenland Snow Chemistry,
W87-08946 5B

Spatial Variability in Selected Physical Characteristics and Processes in Cross Lake, New York,
W87-08973 2H

Robust-Resistant Spatial Analysis of Soil Water Infiltration,
W87-09029 7C

SPAWNING
Seasonality of Blue Mussel, Mytilus edulis L., Larvae in the Damariscotta River Estuary, Maine, 1969-77,
W87-08849 2L

Review of Brown Trout (Salmo trutta) Spawning Beds, Indicating Methods for their Re-establishment in Danish Lowland Rivers,
W87-09047 2H

SPECIATION
Accuracy of Selective Extraction Procedures for Metal Speciation in Model Aquatic Sediments,
W87-08985 5A

SPECIES COMPOSITION
Macrofossil and Pollen Representation of Coniferous Trees In Modern Sediments from Washington,
W87-08690 2H

Vegetation of the Low-Shrub Bogs of Northern New Jersey and Adjacent New York: Ecosystems at Their Southern Limit,
W87-08715 2H

Regulation of Submerged Aquatic Plant Distribution in a Uniform Area of a Weedbed,
W87-08836 2H

Seasonal Distribution of Thermotolerant Free-Living Amoebae. II. Lake Issaqueena,
W87-09225 2H

Distribution of Protozoa in Subsurface Sediments of a Pristine Groundwater Study Site in Oklahoma,
W87-09395 2H

Influence of Substrate Stability on the Composition of Stream Benthos: An Experimental Study,
W87-09403 2H

SPECIES DISTRIBUTION
Prediction of the Occurrence of Four Species of Mosquito Larvae with Logistic Regression on Water-Chemistry Variables,
W87-08846 2H

SPECIES DIVERSITY
Swimming Performance of Fishes Endemic to the Missouri River in South Dakota,
W87-09496 8I

SPECTROPHOTOMETRY
Spectrophotometric Determination of Traces of Silicon in Water after Collection as Silicomolybdenum Blue on an Organic-Solvent-Soluble Membrane Filter,
W87-08833 5A

Absorption of Light by Yellow Substance in Freshwater Lakes,
W87-08934 2H

SPECTROSCOPY
Spectroscopic Methods (Other Than NMR) for Determining Functionality in Humic Substances,
W87-09087 7B

SPHAGNUM
Fate of Some Components of Acidic Deposition in Ombrotrophic Mires,
W87-09382 5B

SPILLED OIL CONTAINMENT KIT
Open Ocean Skimmer Performance Tests,
W87-09562 5G

SPILLWAY CRESTS
Design of Spillway Crests,
W87-09195 8A

SPILLWAYS
Post-Pool Raise Spillway Prototype Test for Chief Joseph Dam Columbia River, Washington,
W87-09153 8A

Model of Stability of Revetments of Earth Spillway Slopes,
W87-09357 8D

SPOIL BANKS
Social and Economic Impacts of Selected Potential Dredged Material Containment Facilities in Long Island Sound.
W87-09471 6B

SPRAY-COLUMNS
'Spray-Column' Laboratory Apparatus for Organic Matter Extraction from Sludges,
W87-08913 5A

SRI LANKA
Heavy Metal Pollution of the Mid-Canal of Kandy: An Environmental Case Study from Sri Lanka,
W87-08840 5C

Sri Lanka's Randenigala Project,
W87-09412 8A

STABILITY ANALYSIS
Stability and Instability of an Adaptive Resource Replacement Strategy in and Agroecological Production System,
W87-08784 6A

Considertion of the Stress-Strain State in Calculations of Slope Stability of Earth Dams,
W87-09356 8D

Kahului Breakwater Stability Study, Kahului, Maui, Hawaii: Hydraulic Model Investigation,
W87-09488 8B

STAGNANT WATER
Stagnant Sulphidic Basin Waters,
W87-08722 2K

STANDARDS
Water Quality Criteria: Protection of Use Perspective,
W87-08629 5G

New Approach for Regulating Iron in Water Quality Standards,
W87-08636 5G

NBS Environmental Standard Reference Materials for Use in Validating Water Analysis,
W87-09127 5A

STATE JURISDICTION
Economic, Legal, and Hydrologic Dimensions of Potential Interstate Water Markets,
W87-09211 6C

STATIC MIXERS
Internal Hydraulics of Diffusers with Uniform Lateral Momentum Distribution,
W87-09366 8B

STATISTICAL ANALYSIS
Relative Accuracy of Satellite and Raingage Rainfall Measurements over Middle Latitudes during Daylight Hours,
W87-08700 2B

Statistical Assessment of a Sampling Pattern for Evaluation of Changes in Mercury and Zinc Concentrations in Patella coerulea,
W87-08884 5A

Radar Rainfall Data Quality Control by the Influence Function Method,
W87-09022 7C

Geochemical Studies in the Drainage Basin of the Rio Vouga, Portugal. IV. Impact of Land Use on the Hydrogeochemistry of Natural Waters in the Vouzela Region,
W87-09207 4C

Statistical Analysis,
W87-09284 5C

Data Intercomparison Theory V. Case Study: Effects of Objective Analysis on a Tropical Pacific Sea Surface Temperature Set,
W87-09502 7C

Data Intercomparison Theory IV. Tercile Tests for Location, Spread and Pattern Differences,
W87-09503 7C

Data Intercomparison Theory II. Trinity Statistics for Location, Spread and Pattern Differences,
W87-09504 7C

Data Intercomparison Theory III. S-Phase and T-Phase Tests for Spatial Pattern and Temporal Evolution,
W87-09505 7C

STATISTICAL METHODS
Experimental Monthly Long Lange Forecasts for the United Kingdom: Part III. Skill of the Monthly Forecasts.
W87-08701 2B

Statistical Techniques for Evaluating Procedures and Results for Periphyton Sampling,
W87-09319 7C

STATISTICAL MODELS
Point Probability Distributions of Frozen Soil,
W87-08696 2C

Correction of Liquid Precipitation,
W87-08813 2B

STATISTICAL STUDIES
Point Probability Distributions of Frozen Soil,
W87-08696 2C

STATISTICS
Generalized Method of Moments as Applied to Problems of Flood Frequency Analysis: Some Practical Results for the Log-Pearson Type 3 Distribution,
W87-08616 2E

Review of Methods of Parameter Estimation for the Extreme Value Type-1 Distribution,
W87-08619 7C

STEADY STATE
Determination of Hydraulic Conductivity from Auger Holes and Pits - An Approximation,
W87-08617 2F

STEADY STATES
Stability and Instability of an Adaptive Resource Replacement Strategy in and Agroecological Production System,
W87-08784 6A

STICKLEBACK
Salinity During Embryonic Development Influences the Response to Salinity of Gasterosteus Aculeatus L. (Trachurus),
W87-08793 2H

STILLING BASINS
Use of Silica-Fume Concrete to Repair a Stilling Basin,
W87-09413 8F

STOCHASTIC HYDROLOGY
Modelling of Unsaturated Flow in Heterogeneous Soils Part II: Stochastic Simulation of Water Flow Over a Field,
W87-08817 2G

STOCHASTIC PROCESS
Stochastic Model for Sediment Yield Using the Principle of Maximum Entropy,
W87-09016 2J

First-Order Reliability Approach to Stochastic Analysis of Subsurface Flow and Contaminant Transport,
W87-09017 5B

STOMATAL CONDUCTANCE
Responses of Gas Exchange to Humidity in Populations of Three Herbs from Environments Differing in Atmospheric Water,
W87-09346 2I

STORM RUNOFF
Introduction to Urban Hydrology and Stormwater Managment,
W87-09097 4C

Rainfall for Urban Stormwater Design,
W87-09098 2B

Desk-Top Methods for Urban Stormwater Calculation,
W87-09100 2A

Urban Runoff Processes,
W87-09101 2A

Quality of Urban Runoff,
W87-09102 5B

Data Collection and Instrumentation,
W87-09103 7B

Overview of Urban Stormwater Models,
W87-09104 4C

STORM SEWERS
Urban Runoff Processes,
W87-09101 2A

STORM SURGES
Optimization of Closure Operations in a Tidal Basin During a Storm-Surge,
W87-08610 4A

STRATIFICATION
Dynamics of Bottom Currents in a Small Lake,
W87-08865 2H

STRATIGRAPHY
Influence of Structure on Underground Water Prediction and Occurrence at Rokana Mine, Kitwe, Zambia,
W87-09572 2F

STREAM BANKS
Streambank Protection by Submerged Vanes,
W87-09198 4D

STREAM DEGRADATION
Man-Induced Gradient Adjustment of the South Fork Forked Deer River, West Tennessee,
W87-09206 6G

STREAM FISHERIES
Physical Structure and Brown Trout (Salmo trutta fario) Populations in Small Danish Lowland Streams,
W87-09059 2H

STREAM IMPROVEMENT
Manual of Stream Channelization Impacts on Fish and Wildlife,
W87-09497 6G

STREAM SANITATION
Applied Stream Sanitation,
W87-09189 2H

STREAMFLOW
Fluvial Hydrology,
W87-08685 2A

Transport of Solids in Streamflow from Coastal Plain Watersheds,
W87-08924 2J

Low Discharge Periods of Rivers in the Upper Vistula River Basin, Poland,
W87-08970 7B

Estimating Baseflow Volume and its Uncertainty,
W87-08971 2E

Applied Stream Sanitation,
W87-09189 2H

STREAMFLOW FORECASTING
Application of Meteorological Radar Data for Simulation of Streamflow with a Hydrological Matrix Model (Utilisation des Donnees d'un Radar Meteorologique pour la Simulation des Ecoulements en Riviere a l'aide d'un Modele Hydrologique Matriciel),
W87-08623 7B

Transformation of Input to a Stochastic Model Using a Distribution Deterministic Model,
W87-08825 2E

Determination of Maximum Design Discharges,
W87-09362 2E

Developments in LARM2: A Longitudinal-Vertical, Time-Varying Hydrodynamic Reservoir Model,
W87-09489 8B

STREAMS
Life Cycles of Four Species of Baetis (Ephemeroptera) in Three Danish Streams,
W87-08764 2H

Use of the Pocketbook Mussel, Lampsilis ventricosa, for Monitoring Heavy Metal Pollution in an Ozark Stream,
W87-08875 5A

Asbestos Fibres Introduce Trace Metals into Streamwater and Sediments,
W87-08912 5B

Digital Controller for Discrete Stage Activation of Automatic Pumping Samplers,
W87-08983 7B

Effects of Copper on the Periphyton of a Small Calcareous Stream,
W87-09318 5C

Mechanics of Sediment Transportation and Alluvial Stream Problems,
W87-09337 2J

Influence of Substrate Stability on the Composition of Stream Benthos: An Experimental Study,
W87-09403 2H

STRENGTH
Assignment of Strength Requirments of Concrete for Large Dams,
W87-09354 8F

STRESS-STRAIN ANALYSIS
Considertion of the Stress-Strain State in Calculations of Slope Stability of Earth Dams,
W87-09356 8D

STROBOSCOPICS
Stroboscopic Determination of Settling Velocity, Size and Porosity of Activated Sludge Flocs,
W87-09263 7B

STRONTIUM
90Sr and 137Cs in Peat Deposits of Low-Lying Bog in the Influence Zone of the Beloyarsk Atomic Power Station,
W87-08710 5B

STRUCTURAL ENGINEERING
Engineering Measures: Waterways and Diversion Channels,
W87-08666 8A

Swimming Performance of Fishes Endemic to the Missouri River in South Dakota,
W87-09496 8I

Protection of the Karstic Springs System in Golubinka Against Contamination by the Sea Water (la Protection du Systeme des Sources Karstiques de Golubinka Contre la Contamination par la Mer),
W87-09582 4B

STRUCTURES
Design and Use of Pressure Sewer Systems,
W87-09309 5D

On-Site Observations of the State of Structures at the Kanev Lock,
W87-09363 7A

SUBGLACIAL DRAINAGE
Subglacial Drainage for an Ice Sheet Resting Upon a Layered Deformable Bed,
W87-09248 2F

SUBMERGED VANES
Streambank Protection by Submerged Vanes,
W87-09198 4D

SUBSIDENCE
Predicting Settlement at a Damsite on a Tunnel Valley Deposit in Alberta,
W87-08795 8A

SUBSTRATE STABILITY
Influence of Substrate Stability on the Composition of Stream Benthos: An Experimental Study,
W87-09403 2H

SUBSTRATES
Hydrodynamics and Structure: Interactive Effects on Meiofauna Dispersal,
W87-08838 2L

Enhanced Uptake of Phosphorus by Activated Sludge - Effect of Substrate Addition,
W87-09270 5D

SUBSURFACE DRAINAGE
Influence of Underground Constructions in Crystalline Rock on Groundwater Conditions and the Use of Artificial Recharge to Restore a Lowered Piezometric Surface,
W87-09589 4B

British Examples of a Hydrogeological Approach to the Evaluation of Drainage Problems in Subsurface Engineering,
W87-09593 2F

Some Hydrogeological Solutions to the Exploitation of Underground Lignite Mines (Quelques Solutions Hydrogeologiques dans la Construction des Mines de Lignite Souterraines),
W87-09597 4B

SUBSURFACE FLOW
First-Order Reliability Approach to Stochastic Analysis of Subsurface Flow and Contaminant Transport,
W87-09017 5B

SUBURBAN AREAS
Influence of Underground Engineering Works on Hydrogeological Conditions of the Suburban Areas,
W87-09581 2F

SUDBURY
Use of Bog Vegetation as a Monitor of Atmospheric Input of Metals,
W87-09182 5C

SUGAR MILLS
Effects of Pollution by Organic Sugar Mill Effluent on the Macro-invertebrates of a Stream in Tropical Queensland, Australia,
W87-09421 5C

SUGAR PINE DAM
Foundation Treatment Using Pneumatically Applied Concrete,
W87-09158 8F

SULFATES
Scavenging of Atmospheric Sulfate by Arctic Snow,
W87-08947 2C

SO2 Oxidation in Cloud Drops Containing NaCl or Sea Salt as Condensation Nuclei,
W87-08950 6E

Kinetics of Sulfate Adsorption and Desorption by Cecil Soil Using Miscible Displacement,
W87-08995 2G

Dynamics of Sulfate Retention by Acid Forest Soils in an Acidic Deposition Environment,
W87-09008 5B

On-Line Sulphate Monitoring by Reversed Flow Injection Analysis and Alternating Reagent Injection,
W87-09261 5A

Decrease in Precipitation Acidity Resulting From Decreased S04(2-) Concentration,
W87-09348 5B

SULFIDES
Stagnant Sulphidic Basin Waters,
W87-08722 2K

SULFUR
Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulfur, Micronutrients,
W87-08689 2G

Atmospheric Deposition of Acidity and Sulfur in Florida,
W87-09177 5B

SULFUR BACTERIA
Microbially Mediated Leaching of Low-Sulfur Coal in Experimental Coal Columns,
W87-09393 5B

SULFUR DIOXIDE
SO2 Oxidation in Cloud Drops Containing NaCl or Sea Salt as Condensation Nuclei,
W87-08950 6E

Decrease in Precipitation Acidity Resulting From Decreased S04(2-) Concentration,
W87-09348 5B

SULFUR GAS
Influence of Sulfur Gas on Water Loss Rate,
W87-08707 2I

SUMAS RIVER
Asbestos Fibres Introduce Trace Metals into Streamwater and Sediments,
W87-08912 5B

SUNFISH
In Vitro Cytotoxicity of Organic Pollutants to Bluegill Sunfish (BF-2) Cells,
W87-08843 5C

SUPERFUND SITES
Evaluating Asphalt Cap Effectiveness at Superfund Site,
W87-09379 5E

SUPEROXIDE
Role of Cupric Ions in the Generation of Superoxide in Natural Waters,
W87-08716 2K

SURFACE-GROUNDWATER RELATIONS
Diffusivity of a Glacial-Outwash Aquifer by the Floodwave-Response Technique,
W87-08754 2F

SURFACE RUNOFF
Effect of Tillage System on Runoff Losses of Surface-Applied Pesticides,
W87-09001 2E

SURFACE SEALING
Effect of Exchangeable Sodium Percent on Surface Sealing,
W87-08742 4D

SURFACE WATER
Surface Manifestations of Internal Oscillations in a Highly Saline Lake (the Dead Sea),
W87-08866 2H

Seasonal Distribution of Legionellae Isolated from Various Types of Water in Israel,
W87-08903 5A

Concentrations of Mercury in Near Shore Surface Waters of the Bay of Biscay and in the Gironde Estuary,
W87-08961 5A

Impact of Agriculture on Surface Water in Ireland: Part I. General,
W87-09199 5B

Impact of Agriculture on Surface Water in Ireland: Part II. Prospects for the Future,
W87-09200 4C

SURFACTANTS
Use of Dispersants on Viscous Fuel Oils and Water in Crude Oil Emulsions,
W87-09511 5G

SURGE IRRIGATION
Surge Irrigation Management,
W87-08744 3F

Control of Furrow Erosion With Crop Residues and Surge Flow Irrigation,
W87-09003 3F

SURVEYS
Presence of Legionella in London's Water Supplies,
W87-08901 5F

Archaeological and Historical Surveys of Selected Portions of the Umatilla Basin Project, Umatilla County, Oregon,
W87-09425 6G

Vulnerability of Selected Lakes and Streams in the Middle Atlantic Region to Acidification: A Regional Survey,
W87-09476 5B

SURVIVAL
Sensitivity of Chronic Endpoints Used in Daphnia Magna Straus Life-Cycle Tests,
W87-08642 5C

SUSPENDED LOAD
Transport of Solids in Streamflow from Coastal Plain Watersheds,
W87-08924 2J

SUSPENDED SEDIMENTS
River Flow with Excessive Suspended Sediment Load: An Evaluation of Turbulent Flow Characteristics,
W87-08826 2E

Suspended Particulate Matter in Commencement Bay,
W87-09498 2J

SUSPENDED SOLIDS
Composition of Suspended Particulate Matter from Scottish Coastal Waters Geochemical Implications for the Transport of Trace Metal Contaminants,
W87-08729 5B

Distribution of Particulate Matter in Relation to the Thermal Cycle in Lake Vechten (The Netherlands): The Significance of Transportation Along the Bottom,
W87-09275 2H

Effects of Intermittent Exposure to Suspended Solids and Turbulence on Three Species of Freshwater Mussels,
W87-09381 6G

SWEDEN
Estimation of Groundwater Recharge in Sandy Till with Two Different Methods Using Groundwater Level Fluctuations,
W87-08615 2F

Introduction of Mysis relicta in Sweden: Effects on Fish in Impounded Lakes,
W87-09057 2H

Modeling of Atmospheric Particulate Deposition to Natural Waters,
W87-09166 5B

SWIMMING
Swimming Performance of Fishes Endemic to the Missouri River in South Dakota,
W87-09496 8I

SYMPOSIUM
Aquatic Toxicology and Hazard Assessment: Eighth Symposium.
W87-08624 6E

Habitat Modification and Freshwater Fisheries.
W87-09036 4C

Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms.
W87-09311 5C

SYNERGISTIC EFFECTS
Toxicity of Chemical Mixtures,
W87-09286 5C

TADPOLES
Lethal Effects of Diquat and Paraquat on Developing Frog Embryos and 15-Day-Old Tadpoles, Rana pipiens,
W87-09235 5C

TAILINGS PONDS
Comparative Effects of Mine Wastes on the Benthos of an Acid and an Alkaline Pond,
W87-08962 5C

TANK IRRIGATION
Small-Scale Surface (Tank) Irrigation in Asia,
W87-09015 3F

TANNINS
Methanogenic Toxicity and Anaerobic Degradability of a Hydrolyzable Tannin,
W87-09278 5D

TASTE
Removal of Individual Off-Flavour Compounds in Water During Artificial Groundwater Recharge and During Treatment by Alum Coagulation/Sand Filtration,
W87-09267 5F

TASTES
Control of Tastes and Odors in Drinking Water with Ozone,
W87-09137 5F

TEMPERATURE
Thermal and Dissolved Oxygen Characteristics of a South Carolina Cooling Reservoir,
W87-08975 2H

Climate Forecast Verifications, U.S. Mainland, 1974-82,
W87-09499 2B

Data Intercomparison Theory I. Minimal Spanning Tree Tests for Location and Scale Differences,
W87-09501 7C

TEMPERATURE CONTROL
Effects of Storage Reallocation on Thermal Characteristics of Cowanesque Lake, Pennsylvania: Numerical Model Investigation,
W87-09485 2H

TEMPERATURE EFFECTS
Seasonality of Blue Mussel, Mytilus edulis L., Larvae in the Damariscotta River Estuary, Maine, 1969-77,
W87-08849 2L

Forest Soil Organic Horizon Acidification: Effects of Temperature, Time, and Solution/Soil Ratio,
W87-09009 2G

Responses of Leaf Water Potential and Leaf Diffusive Resistance to Abscisic Acid, Water Stress and Low Temperature in Hibiscus esculentus: The Effect of Water Stress and ABA Pre-Treatments,
W87-09210 2D

Spring and Summer Movements of Subadult Striped Bass, Morone saxatilis, in the Connecticut River,
W87-09253 2H

Concrete Temperature Control During Dam Construction,
W87-09408 8F

TEMPORAL VARIATION
Seasonal and Spatial Trends in South Greenland Snow Chemistry,
W87-08946 5B

TENNESSEE
Man-Induced Gradient Adjustment of the South Fork Forked Deer River, West Tennessee,
W87-09206 6G

Impact of Trinitrotoluene Wastewaters on Aquatic Biota in Lake Chickamauga, Tennessee,
W87-09322 5C

TERCILE METHOD
Data Intercomparison Theory IV. Tercile Tests for Location, Spread and Pattern Differences,
W87-09503 7C

TERNS
Embryotoxicity, Teratogenicity, and Aryl Hydrocarbon Hydroxylase Activity in Forster's Terns on Green Bay, Lake Michigan,
W87-08841 5C

TERRACING
Engineering Measures for Soil and Water Conservation: Terracing and Benching,
W87-08667 3F

TEST HOLES
Determination of Hydraulic Conductivity from Auger Holes and Pits - An Approximation,
W87-08617 2F

Monitoring Well Installation, Purging, and Sampling Techniques - Part 1: Conceptualizations,
W87-08755 7B

TEST WELLS
Monitoring Well Installation, Purging, and Sampling Techniques - Part 1: Conceptualizations,
W87-08755 7B

Role of Hydrogeology in Coal Mining Near Chandrapur in Maharashtra, India,
W87-09569 2F

TESTING PROCEDURES
Harmonization of Biological Testing Methodology: A Performance-Based Approach,
W87-08646 5A

Alternative Procedure for Determining the Shrinkage Limit of Soil,
W87-09159 2G

Acute Toxicity Tests,
W87-09281 5C

Early Life Stage Toxicity Tests,
W87-09282 5C

Method for Evaluating the Impact of Radioactivity on Phytoplankton,
W87-09317 5C

Statistical Techniques for Evaluating Procedures and Results for Periphyton Sampling,
W87-09319 7C

TEXAS
Onshore Impacts and Cleanup During the Burmah Agate Oil Spill - November 1979,
W87-09518 5C

Burmah Agate - Chronology and Containment Operations,
W87-09519 5B

Surveillance, Tracking, and Model Correlation of the Spill from the Tanker Burmah Agate,
W87-09520 7B

Response to the Esso Bayway Oil Spill,
W87-09549 5G

Impact of the Esso Bayway Oil Spill on Salt Marsh Macro Fauna,
W87-09550 5C

Effects of the Ixtoc I Oil Spill on Texas Shorebird Populations,
W87-09555 5C

THAMES RIVER
Ameliorative Methods to Reinstate Fisheries Following Land Drainage Operations,
W87-09048 6G

THEIS NONEQUILIBRIUM SOLUTION
Alternate Procedure for Analyzing Aquifer Tests Using the Theis Nonequilibrium Solution,
W87-08756 7C

THERMAL CONDUCTIVITY PROBE
Measurement of Soil Water Content Using the Combined Time-Domain Reflectometry - Thermal Conductivity Probe,
W87-08796 2G

THERMAL POLLUTION
Ecological Factors in the Selection of Representative Species for Thermal Effluent Demonstrations,
W87-09315 5C

THERMAL STRATIFICATION
Internal Waves of the Second Vertical Mode in a Stratified Lake,
W87-08863 2H

Distribution of Particulate Matter in Relation to the Thermal Cycle in Lake Vechten (The Netherlands): The Significance of Transportation Along the Bottom,
W87-09275 2H

Effects of Storage Reallocation on Thermal Characteristics of Cowanesque Lake, Pennsylvania: Numerical Model Investigation,
W87-09485 2H

THERMAL STRESS
Effects of Suspended Volcanic Ash and Thermal Shock on Susceptibility of Juvenile Salmonids to Disease,
W87-08653 5C

Seasonal Distribution of Thermotolerant Free-Living Amoebae. II. Lake Issaqueena,
W87-09225 2H

THORNE WASTE
Plants and Peat Cuttings: Historical Ecology of a Much Exploited Peat land-Thorne Waste. Yorkshire, UK,
W87-09342 4C

THROUGHFALL
Interception Losses of Rainfall from Cashew Trees,
W87-08621 2I

Estimation of Canopy Reservoir Capacity and Oxygen-18 Fractionation in Throughfall in a Pine Forest,
W87-08814 2B

THYMIDINE
Thymidine Incorporation and Microbial Respiration in the Surface Sediment of a Hypereutrophic Lake,
W87-08936 2H

THYROID
Lead Nitrate Induced Changes in the Thyroid Physiology of the Catfish Clarias batrachus (L),
W87-08850 5C

THYROID HORMONES
Pesticide-Induced Changes in Peripheral Thyroid Hormone Levels during Different Reproductive Phases in Heteropneustes fossilis,
W87-08858 5C

TIDAL AREAS
Growth and Survival of Giant Ragweed (Ambrosia trifida L.) in a Delaware River Freshwater Tidal Wetland,
W87-08714 2H

TIDAL BASINS
Optimization of Closure Operations in a Tidal Basin During a Storm-Surge,
W87-08610 4A

TIDAL FLATS
Examination of Tidal Flats, Vol. 1: Research Report.
W87-09492 4C

Examination of Tidal Flats, Vol. 3: Evaluation Methodology.
W87-09493 4C

TIDAL RIVERS
Immunological Dietary Analysis of Two Penaeid Shrimp Species from a South Carolina Tidal Creek,
W87-08988 2L

TIDE LANDS
Establishing Smooth Cordgrass in Tidal Wetlands,
W87-08806 2I

TILL BASINS
Modelling Water Exchange and Transit Times in Till Basins Using Oxygen-18,
W87-08821 2A

TILLAGE EFFECTS
Influence of Long Term Cultural Operations on Physical and Water Retention Characters of a Red Sandy Loam Soil,
W87-08773 2G

Effect of Tillage System on Runoff Losses of Surface-Applied Pesticides,
W87-09001 2E

Soil Water Evaporation Comparisons Among Tillage Practices in the Northern Great Plains,
W87-09006 2D

TIME-DOMAIN REFLECTOMETRY
Measurement of Soil Water Content Using the Combined Time-Domain Reflectometry - Thermal Conductivity Probe,
W87-08796 2G

TIME SERIES ANALYSIS
Generalized Method of Moments as Applied to Problems of Flood Frequency Analysis: Some Practical Results for the Log-Pearson Type 3 Distribution,
W87-08616 2E

Review of Methods of Parameter Estimation for the Extreme Value Type-1 Distribution,
W87-08619 7C

TIMES BEACH
Environmental Mobility of Dioxins,
W87-08658 5B

TISSUE ANALYSIS
Organochlorine Pesticide Residues in Fish from the Shatt al-Arab River, Iraq,
W87-08880 5B

Cadmium Contamination in American Lobster, Homarus americanus, Near a Coastal Lead Smelter: Use of Multiple Linear Regression for Management,
W87-08882 5C

Cadmium and Lead in Lake Ontario Salmonids,
W87-08883 2H

Statistical Assessment of a Sampling Pattern for Evaluation of Changes in Mercury and Zinc Concentrations in Patella coerulea,
W87-08884 5A

Research in Environmental Pollution: II. Determination of Polychlorinated Nitrobenzenes (PCNB's) in Main River Fish,
W87-08895 5A

Contamination of Fish from the French Zone of Lake Leman by Organochlorine Compounds between 1973 and 1981 (Contamination des Poissons du Secteur Francais du Lac Leman, par les Composes Organochlores entre 1973 et 1981),
W87-08909 2H

Residues of Organochlorine Pesticides in Environmental Samples from the Shatt-al-Arab River, Iraq,
W87-08910 5B

Disposition of Low and High Environmental Concentrations of PCBs in Snapping Turtle Tissues,
W87-09234 5B

Histopathology,
W87-09290 5C

TISSUE CULTURE
In Vitro Cytotoxicity of Organic Pollutants to Bluegill Sunfish (BF-2) Cells,
W87-08843 5C

TOLUENE
In Vitro Cytotoxicity of Organic Pollutants to Bluegill Sunfish (BF-2) Cells,
W87-08843 5C

Effectiveness of Offshore Produced Water Treatment,
W87-09515 5D

TOMATOES
Effects of Water Stress on Flowering and Fruit Set in Processing-Tomatoes,
W87-08770 2I

TOPOGRAPHY
Use of Topological Information in Hydrograph Estimation,
W87-08976 2E

TORTULA
Glutathione Status and Protein Synthesis During Drought and Subsequent Rehydration in Tortula ruralis,
W87-09417 2I

TOXAPHENE
Formation of Toxaphene-Like Contaminants During Simulated Paper Pulp Bleaching,
W87-09093 5B

TOXIC WASTES
Determination of Toxic Organophosphorus Compounds by Specific and Nonspecific Detectors,
W87-09220 5A

TOXICITY
Hydrogen Sulfide Poisonings in Hot-Spring Reservoir Cleaning: Two Case Reports,
W87-08614 5C

TOXICITY

Clean Water Act Update: A New Role for Toxicology,
W87-08627 6E

Research Needs for Rapid Assessments of Chronic Toxicity,
W87-08630 5C

Research Needs in Developing Structure Activity Relationships,
W87-08633 5C

Comparison of QSAR Predictions with Fish Toxicity Screening Data for 110 Phenols,
W87-08637 5C

Field Confirmation of a Laboratory-Derived Hazard Assessment of the Acute Toxicity of Fenthion to Pink Shrimp, Penaeus duorarum,
W87-08638 5C

Time/Toxicity Relationships in Short-Term Static, Dynamic, and Plug-Flow Bioassays,
W87-08639 5C

Acute Toxicity of Chlorine on Freshwater Organisms: Time-Concentration Relationships of Constant and Intermittent Exposures,
W87-08640 5C

Sensitivity of Chronic Endpoints Used in Daphnia Magna Straus Life-Cycle Tests,
W87-08642 5C

Toxicity of Aqueous Extracts of Natural and Synthetic Oils to Three Species of Lemna,
W87-08647 5C

Advantages of Using Regression Analysis to Calculate Results of Chronic Toxicity Tests,
W87-08650 5C

Appropriate Durations and Measures for Ceriodaphnia Toxicity Tests,
W87-08654 5C

Rapid Aquatic Toxicity Assay Using Incorporation of Tritiated-Thymidine into Sea Urchin, Arbacia punctulata, Embryo: Evaluation of Toxicant Exposure Procedures,
W87-08655 5C

Acute and Chronic Toxicity to the Fathead Minnow, Pimephales promelas, of Effluents from a Treatment Plant Receiving Dye and Pigment Processing Wastewater,
W87-08656 5C

Embryotoxicity, Teratogenicity, and Aryl Hydrocarbon Hydroxylase Activity in Forster's Terns on Green Bay, Lake Michigan,
W87-08841 5C

In Vitro Cytotoxicity of Organic Pollutants to Bluegill Sunfish (BF-2) Cells,
W87-08843 5C

Lead Nitrate Induced Changes in the Thyroid Physiology of the Catfish Clarias batrachus (L),
W87-08850 5C

Quantitative and Qualitative Aspects of Fish Crop in Relation to Environmental Quality,
W87-08855 5C

Effects of Lowered Dissolved Oxygen Concentration on the Toxicity of 1,2,4-Trichlorobenzene to Fathead Minnows,
W87-08879 5C

Acute Toxicity of Emulsifiable Concentrations of Three Insecticides Commonly Found in Nonpoint Source Runoff into Estuarine Waters to the Mummichog, Fundulus heteroclitus,
W87-08881 5C

Hexavalent Chromium Effects on Carbon Assimilation in Selenastrum capricornutum,
W87-08886 5C

Correlation between Heavy Metal Acute Toxicity Values in Daphnia magna and Fish,
W87-08887 5A

Factors Influencing Acute Toxicity of Coal Ash to Rainbow Trout (Salmo gairdneri) and Bluegill Sunfish (Lepomis macrochirus),
W87-08978 5C

Comparative Toxicity of SRC-I Wastewater to Aquatic Organisms,
W87-09106 5C

Drinking Water: A Global Victual,
W87-09116 5C

Water Treatment Chemicals Codex,
W87-09121 5F

Determination of Toxic Organophosphorus Compounds by Specific and Nonspecific Detectors,
W87-09220 5A

Freshly Prepared Rat Hepatocytes Used in Screening the Toxicity of Blue-Green Algal Blooms,
W87-09230 5A

Toxic Effects of Organic Solvents on the Growth of Blue-Green Algae,
W87-09236 5C

Safety Factor for LC50 Values Allowing for Differences in Sensitivity Among Species,
W87-09266 5C

Methanogenic Toxicity and Anaerobic Degradability of a Hydrolyzable Tannin,
W87-09278 5D

Fundamentals of Aquatic Toxicology: Methods and Applications.
W87-09280 5C

Acute Toxicity Tests,
W87-09281 5C

Early Life Stage Toxicity Tests,
W87-09282 5C

Chronic Toxicity Tests,
W87-09283 5C

Statistical Analysis,
W87-09284 5C

Factors that Modify Toxicity,
W87-09285 5C

Toxicity of Chemical Mixtures,
W87-09286 5C

Microbial Toxicity Studies,
W87-09287 5C

Behavior,
W87-09288 5C

Biochemistry/Physiology,
W87-09289 5C

Pesticides,
W87-09291 5C

Trace Metals,
W87-09292 5C

Polycyclic Aromatic Hydrocarbons,
W87-09293 5C

Ammonia, Nitrite, and Nitrate,
W87-09294 5C

Analytical Chemistry,
W87-09295 5B

Bioaccumulation,
W87-09296 5B

Biotransformation,
W87-09297 5B

Fate Modeling,
W87-09298 5B

Environmental Legislation,
W87-09299 6E

Field Validation,
W87-09300 7A

Chemical Safety Evaluation,
W87-09301 5B

Effluent Evaluation,
W87-09302 5A

Response of Marine Animals to Petroleum and Specific Petroleum Hydrocarbons,
W87-09308 5C

Use of Asiatic Clam Larvae in Aquatic Hazard Evaluations,
W87-09326 5C

Induction of Siderophore Activity in Anabaena spp. and Its Moderation of Copper Toxicity,
W87-09386 5G

Toxicity of Ballast-Water Treatment Effluent to Marine Organisms at Port Valdez, Alaska,
W87-09514 5C

Toxicity of Chemically Dispersed Oil to Shrimp Exposed to Constant and Decreasing Concentrations in a Flowing System,
W87-09516 5C

Effects of Dimethylnaphthalene and Fluctuating Temperatures on Estuarine Shrimp,
W87-09517 5C

TOXICOLOGY

Xenobiotic-Metabolizing Enzyme Systems in Test Fish: I. Comparative Studies of Liver Microsomal Monooxygenases,
W87-08852 5C

TRACE ELEMENTS

Geochemistry, Soils and Cardiovascular Diseases,
W87-08692 2F

Possible Influence of the Components of the Soil and Lithosphere on the Development and Growth of Neoplasms,
W87-08693 2K

Epidemiology of Dental Caries in Relation to Environmental Trace Elements,
W87-08694 5C

Spectrophotometric Determination of Traces of Silicon in Water after Collection as Silicomolybdenum Blue on an Organic-Solvent-Soluble Membrane Filter,
W87-08833 5A

Complete HF Digestion Method for Element and Trace Element Determination in Soils, Sediments, Sludges and Other Similar Samples Using a Closed System (HF-Totalaufschluss im geschlossenen System fur Element- und Spurenelementbestimmungen in Boden, Klarschlamm, Sedimenten u. a. Proben),
W87-08894 5A

Effect of Storage on the Distribution of Trace Elements (Lead, Cadmium, Copper, Zinc and Mercury) in Natural Water,
W87-08914 5A

Selenium in the Tributaries of the Orinoco in Venezuela,
W87-09406 2K

TRACE LEVELS
Systematic Approach to Adsorption on XAD-2 Resin for the Concentration and Analysis of Trace Organics in Water Below the (mu)g/l Level,
W87-09011 5A

TRACE METALS
Chemistry of the River Niger II. Trace Metals,
W87-08720 2K

Asbestos Fibres Introduce Trace Metals into Streamwater and Sediments,
W87-08912 5B

Accuracy of Selective Extraction Procedures for Metal Speciation in Model Aquatic Sediments,
W87-08985 5A

Trace Metal and Strong Acid Composition of Rain and Snow in Northern Minnesota,
W87-09178 5B

Transport and Dry Deposition of Trace Metals over Southern Lake Michigan,
W87-09179 5B

Adsorption of Inorganic Pollutants in Aquatic Systems,
W87-09194 5B

Trace Metals,
W87-09292 5C

TRACERS
Tracer Study of Vertical Exchange by Cumulus Clouds,
W87-08699 2A

Comparison of Field and Laboratory Methods for Determining Contaminant Flow Parameters,
W87-08757 5B

Performance and Analysis of Aquifer Tracer Tests with Implications for Contaminant Transport Modeling - A Project Summary,
W87-08759 5B

Modelling Water Exchange and Transit Times in Till Basins Using Oxygen-18,
W87-08821 2A

Sedimentation and Bioturbation in a Salt Marsh as Revealed by 210Pb, 137Cs, and 7Be Studies,
W87-08932 2L

Evaluation of Natural Tracers in an Acidic and Metal-Rich Stream,
W87-09021 7B

In Situ Cosmogenic 3H, 14C, and 10Be for Determining the Net Accumulation and Ablation Rates of Ice Sheets,
W87-09249 2C

Application of Isotope Techniques and Well Loggind in Investigating Ground Water Influenced by Mining,
W87-09580 2F

TRANSDUCTION
Potential for Transduction of Plasmids in a Natural Freshwater Environment: Effect of Plasmid Donor Concentration and a Natural Microbial Community on Transduction in Pseudomonas aeruginosa,
W87-09390 2H

TRANSFER RATES
Transfer Rates of Gaseous Pollutants Between the Atmosphere and Natural Waters,
W87-09167 5B

TRANSPIRATION
Field Water Relations of a Compass Plant, Lactuca serriola L.,
W87-08772 2I

Model for Predicting the Influence of Moisture Stress on Crop Losses Caused by Ozone,
W87-08783 2I

TRANSPIRATION RATE
Influence of Sulfur Gas on Water Loss Rate,
W87-08707 2I

TRANSPORT EQUATIONS
Elimination of Time Assignment Bias in Estimates of Dispersion Coefficient,
W87-08994 7C

TREES
Estimation of Canopy Reservoir Capacity and Oxygen-18 Fractionation in Throughfall in a Pine Forest,
W87-08814 2B

TRIBUTARIES
Man-Induced Gradient Adjustment of the South Fork Forked Deer River, West Tennessee,
W87-09206 6G

TRICHLOROBENZENE
Effects of Lowered Dissolved Oxygen Concentration on the Toxicity of 1,2,4-Trichlorobenzene to Fathead Minnows,
W87-08879 5C

TRICHLOROETHYLENE
Distribution Coefficient of Trichloroethylene in Soil-Water Systems,
W87-08752 5B

Biodegradation of Trichloroethylene and Involvement of an Aromatic Biodegradative Pathway,
W87-09387 5D

TRICHLOROPHENOXYACETIC ACID
Adsorption of 2,4,5-T by Active Carbons from Aqueous Solution,
W87-09254 5D

TRICKLE IRRIGATION
Bare Soil Evaporation Near a Surface Point-Source Emitter,
W87-08743 2D

Advances in Irrigation, Volume 3.
W87-09464 3F

Traveling Trickle Irrigation System,
W87-09465 3F

TRICKLING FILTERS
Scale-Up of Activated Sludge and Trickling Filter Processes,
W87-09451 5D

Efficiency and Process: Stability of Single Stage and Multi-Stage Wastewater Treatment Plants,
W87-09452 5D

TRIETHYLENE GLYCOL
Effects of Triethylene Glycol on Mysidopsis bahia (Crustacea: Mysidacea) and Menidia peninsulae (Pisces: Atherinidae),
W87-08644 5C

TRIHALOMETHANES
Curbing THMs in Small Water Systems,
W87-08954 5F

Trihalomethane Formation in Whirlpool Spas,
W87-09276 5B

TRINITROTOLUENE
Impact of Trinitrotoluene Wastewaters on Aquatic Biota in Lake Chickamauga, Tennessee,
W87-09322 5C

TRITIUM
Rapid Aquatic Toxicity Assay Using Incorporation of Tritiated-Thymidine into Sea Urchin, Arbacia punctulata, Embryo: Evaluation of Toxicant Exposure Procedures,
W87-08655 5C

Statistical Structure and Filter Characteristics of Tritium Fluctuations in Fractured Basalt,
W87-09027 5B

TROPHIC LEVEL
Trophic Interactions in the Plankton of Malyi Sevan in July, 1984,
W87-09219 2H

TROPICAL AREAS
Rainfall in the Wet-Dry Tropics: Extreme Events at Darwin and Similarities Between Years During the Period 1870-1983 Inclusive,
W87-08775 2B

TROPICAL REGIONS
Interception Losses of Rainfall from Cashew Trees,
W87-08621 2I

TROPICAL STORMS
Extreme Floods in Southern Africa Caused by Tropical Cyclone Domoina,
W87-09410 2F

TROUT
Bioconcentration of Four Chlorinated Dioxins by Rainbow Trout and Fathead Minnows,
W87-08659 5B

Lake Effect on Stream Living Brown Trout (Salmo trutta),
W87-08763 2H

Toxicity of Picloram (4-Amino-3,5,6-Trichloropicolinic Acid) to Life Stages of the Rainbow Trout,
W87-08877 5C

Cadmium and Lead in Lake Ontario Salmonids,
W87-08883 2H

Correlation between Heavy Metal Acute Toxicity Values in Daphnia magna and Fish,
W87-08887 5A

Factors Influencing Acute Toxicity of Coal Ash to Rainbow Trout (Salmo gairdneri) and Bluegill Sunfish (Lepomis macrochirus),
W87-08978 5C

Repurcussion of Small Hydroelectric Power Stations on Populations of Brown Trout (Salmo trutta) in Rivers in the French Massif-Central,
W87-09041 6G

Review of Brown Trout (Salmo trutta) Spawning Beds, Indicating Methods for their Re-establishment in Danish Lowland Rivers,
W87-09047 2H

Physical Structure and Brown Trout (Salmo trutta fario) Populations in Small Danish Lowland Streams,
W87-09059 2H

Natural Propagation and Habitat Improvement - Washington, Volume IIA - Tumwater Falls and Dryden Dam Fish Passage.
W87-09109 8I

TU MEN RIVER
Modelling of BOD-DO Dynamics in an Ice-Covered River in Northern China,
W87-09262 5B

TUCSON AQUEDUCT
Tucson Aqueduct Phase B Central Arizona Project: Archaeological Data Recovery Studies, 1985-1986 Annual Report,
W87-09329 6G

TUNDRA PONDS
Ecological and Physiological Differentiation Among Low-Arctic Clones of Daphnia Pulex,
W87-08691 2H

TUNNEL CONSTRUCTION
Geotechnical Aspects of Corani Reservoir Enlargement,
W87-08794 8A

Influence of Underground Constructions in Crystalline Rock on Groundwater Conditions and the Use of Artificial Recharge to Restore a Lowered Piezometric Surface,
W87-09589 4B

Hydrogeological Aspects of Ground Water Inflow in the Juktan Tunnels, Sweden,
W87-09591 2F

System of Underground Water in a Karstic Country and the Tunnels Excavated for Water Transport to Athens (le Regime des Eaux Souterraines dans un Pays Karstique et les Galeries de la Grande Adduction d'Eau d'Athenes),
W87-09595 2F

TUNNEL HYDRAULICS
Hydrogeological Aspects of Ground Water Inflow in the Juktan Tunnels, Sweden,
W87-09591 2F

System of Underground Water in a Karstic Country and the Tunnels Excavated for Water Transport to Athens (le Regime des Eaux Souterraines dans un Pays Karstique et les Galeries de la Grande Adduction d'Eau d'Athenes),
W87-09595 2F

TUNNELING
Hydrogeological Aspects of Ground Water Inflow in the Juktan Tunnels, Sweden,
W87-09591 2F

System of Underground Water in a Karstic Country and the Tunnels Excavated for Water Transport to Athens (le Regime des Eaux Souterraines dans un Pays Karstique et les Galeries de la Grande Adduction d'Eau d'Athenes),
W87-09595 2F

TUNNELS
Temperature and Flow Conditions in a Reservoir with a Submerged Outlet Tunnel During the Winter Period,
W87-08828 2H

Hydrogeological Aspects of Ground Water Inflow in the Juktan Tunnels, Sweden,
W87-09591 2F

TURBIDITY
Effect of 'Whiting' on Optical Properties and Turbidity in Owasco Lake, New York,
W87-08966 2H

Fish Predation on Juvenile Brown Shrimp, Penaeus Aztecus Ives: Effects of Turbidity and Substratum on Predation Rates,
W87-09252 2H

Suspended Particulate Matter in Commencement Bay,
W87-09498 2J

TURBIFICIDS
Enhancement of Inorganic Nitrogen and Phosphate Release from Lake Sediment by Tubificid Worms and Chironomid Larvae,
W87-09404 2H

TURBINES
Measures to Reduce the Level of Vibrations of Turbine-Generator Units,
W87-09365 8C

Status of DOE Small Hydropower Research and Development Projects.
W87-09478 8C

TURBULENCE
Sediment Diffusion in Primary Shallow Rectangular Clarifiers,
W87-09376 5F

Effects of Intermittent Exposure to Suspended Solids and Turbulence on Three Species of Freshwater Mussels,
W87-09381 6G

Turbulence Statistics in Fully Developed Channel Flow at Low Reynolds Number,
W87-09383 8B

TURBULENT FLOW
River Flow with Excessive Suspended Sediment Load: An Evaluation of Turbulent Flow Characteristics,
W87-08826 2E

Lateral Mixing in Channels Due to Secondary Currents,
W87-08827 2E

Turbulence Statistics in Fully Developed Channel Flow at Low Reynolds Number,
W87-09383 8B

TYRRHENIAN SEA
Mercury Pollution in Marine Sediment Cores Near Cinnabar Deposits and a Chlor-Alkali Plant,
W87-08727 5B

ULTRAFILTRATION
Removal of Multivalent Metal Cations from Water Using Micellular-Enhanced Ultrafiltration,
W87-09223 2K

ULTRAVIOLET RADIATION
Potassium Ferrioxalate as Chemical Actinometer in Ultraviolet Reactors,
W87-09377 5F

UNDERGROUND WASTE DISPOSAL
Geologic Isolation of High-Level Radioactive Waste: Putting It Away Forever,
W87-08805 5E

Wastewater-Induced Soil Clogging Development,
W87-09373 5C

UNITED KINGDOM
Quantities of Cadmium, Lead, Mercury and Arsenic Entering the U.K. Environment from Human Activities,
W87-08728 5B

UNIVERSAL SOIL LOSS EQUATION
Soil Erosion Process,
W87-08663 2J

UNSATURATED FLOW
Finite Element Analysis of Water Flow in Variably Saturated Soil,
W87-08620 2G

Variation of the Subsoil Hydraulic Conductivities of Some New Zealand Soils with Changes in Water Tension,
W87-08736 2G

Modelling of Unsaturated Flow in Heterogeneous Soils Part I: Deterministic Simulations of Water Flow in Soil Profiles,
W87-08816 2G

Modelling of Unsaturated Flow in Heterogeneous Soils Part II: Stochastic Simulation of Water Flow Over a Field,
W87-08817 2G

Modeling the Flow of Immiscible Fluids in Soils,
W87-09258 2G

UNSTEADY FLOW
Unsteady Flow to Wells in Layered and Fissured Aquifer Systems,
W87-08618 2F

Reverse Pathline Calculation of Time-Related Capture Zones in Nonuniform Flow,
W87-08753 2F

Computation of Unsteady Flows in the Alabama River,
W87-08980 2E

UPFLOW ANAEROBIC FILTERS
Anaerobic Treatment of Distillery Slops Using an Upflow Anaerobic Filter Reactor,
W87-08890 5D

URANIUM
Orientation Study of St. Francois Mountain and Decaturville Precambrian Areas, Missouri,
W87-09459 2K

URBAN AREAS
Characterization of the PAC Profile in Settling Particulates from the Urban Waters of Stockholm,
W87-09237 5B

URBAN DRAINAGE
Introduction to Urban Hydrology and Stormwater Managment,
W87-09097 4C

Desk-Top Methods for Urban Stormwater Calculation,
W87-09100 2A

Urban Runoff Processes,
W87-09101 2A

URBAN HYDROLOGY
Urban Stormwater Hydrology.
W87-09096 4C

Introduction to Urban Hydrology and Stormwater Managment,
W87-09097 4C

Rainfall for Urban Stormwater Design,
W87-09098 2B

Rainfall Abstractions,
W87-09099 2A

Desk-Top Methods for Urban Stormwater Calculation,
W87-09100 2A

Urban Runoff Processes,
W87-09101 2A

Quality of Urban Runoff,
W87-09102 5B

Data Collection and Instrumentation,
W87-09103 7B

Overview of Urban Stormwater Models,
W87-09104 4C

Example Model Applications,
W87-09105 4C

URBAN RUNOFF
Urban Stormwater Hydrology.
W87-09096 4C

Introduction to Urban Hydrology and Stormwater Managment,
W87-09097 4C

Rainfall Abstractions,
W87-09099 2A

Desk-Top Methods for Urban Stormwater Calculation,
W87-09100 2A

Urban Runoff Processes,
W87-09101 2A

Quality of Urban Runoff,
W87-09102 5B

Data Collection and Instrumentation,
W87-09103 7B

Overview of Urban Stormwater Models,
W87-09104 4C

Example Model Applications,
W87-09105 4C

URINE
Analysis of Pentachlorophenol in Water and Urine by Enrichment with Lipidex(R) 5000,
W87-08896 5A

USSR
Concrete Dam of the Denin Dnepr Hydroelectric Station,
W87-09352 8A

On-Site Observations of the State of Structures at the Kanev Lock,
W87-09363 7A

Seepage Regime in the Foundation of the Kanev Hydroelectric Station,
W87-09364 8D

UTAH
Prehistoric Cultural Resources Study Predictive Model and Field Survey Weber Basin Project,
W87-09335 6G

VACUUM TROUGH COLLECTORS
Vacuum Trough Extractors for Measuring Drainage and Nitrate Flux Through Sandy Soils,
W87-08989 7B

VAIKKOJOKI RIVER
Restoration of the River Vaikkojoki, Finland,
W87-09046 2H

VANCOUVER
Longer-Duration Post-Frontal Precipitation at Vancouver International Airport, 1953-1983,
W87-08809 2B

VAPOR PRESSURE
Responses of Gas Exchange to Humidity in Populations of Three Herbs from Environments Differing in Atmospheric Water,
W87-09346 2I

VC MEDIUM
Evaluation of the Multitest Medium for Rapid Presumptive Identification of Vibrio cholerae from Environmental Sources,
W87-09397 5A

VEGETABLE CROPS
Effect of Fertilization with Municipal Sludge on the Glutathione, Polyamine, and Cadmium Content of Cole Crops and Associated Loopers (Trichoplusia ni),
W87-08835 5C

VENDING MACHINES
Bacteriological Quality of Drinks From Vending Machines,
W87-08704 5F

VENTILATION
Outbreak of Legionnaires' Disease in Glasgow Royal Infirmary: Microbiological Aspects,
W87-08703 5C

VERTICAL FLOW
Vertical Transport of Heavy Metals by Settling Particles in Lake Zurich,
W87-08869 5B

VIBRATION
Measures to Reduce the Level of Vibrations of Turbine-Generator Units,
W87-09365 8C

VIBRIO
Evaluation of the Multitest Medium for Rapid Presumptive Identification of Vibrio cholerae from Environmental Sources,
W87-09397 5A

VICTORIA
Perennial Pasture Production after Irrigation with Saline Groundwater in the Goulburn Valley, Victoria,
W87-09208 3C

VIRGIN RIVER
Study of Saline Water Use at the Harry Allen Generating Station,
W87-09332 3C

VIRUSES
A-ELISA to Detect Hepatitis A Virus in Estuarine Samples,
W87-09396 5A

VISTULA RIVER
Fall of Migratory Fish Populations and Changes in Commercial Fisheries in Impounded Rivers in Poland,
W87-09039 6G

VISTULA RIVER BASIN
Low Discharge Periods of Rivers in the Upper Vistula River Basin, Poland,
W87-08970 7B

VOLATILE ORGANIC COMPOUNDS
Air-Water Phase Equilibria of Volatile Organic Solutes,
W87-08956 5F

Gas Chromatographic Analysis of Volatile Compounds in Water and Biological Samples with an Automatic Injector,
W87-09012 7B

New Method for Determining the Concentrations of Volatile Organic Compounds in Sediment Interstitial Water,
W87-09233 5A

VOLATILITY
Volatilization Loss of Nitrogen from Submerged Saline Soil,
W87-08892 2G

VOLATILIZATION
Attempt to Measure the Flow of Chlorinated Hydrocarbons, such as PCBs, from Water to Air in the Field,
W87-09246 7B

VOLCANIC ASH
Effects of Suspended Volcanic Ash and Thermal Shock on Susceptibility of Juvenile Salmonids to Disease,
W87-08653 5C

VOLUME
Analysis of Volume Change in Unconfined Units of Soil,
W87-08992 2G

VORTICITY FIELDS
Consistent Parameterization of the Effects of Cumulus Clouds on the Large-Scale Momentum and Vorticity Fields,
W87-08938 2B

WABASH RIVER
Ecological Factors in the Selection of Representative Species for Thermal Effluent Demonstrations,
W87-09315 5C

Role of Electrofishing in Assessing Environmental Quality of the Wabash River,
W87-09328 5A

WADI DHULEIL
Proposals for Agricultural Development of Wadi Dhuleil Catchment, Jordan,
W87-08739 3F

WALES
Effects on Salmonid Populations of Isolation of a Lake From a River System,
W87-09051 6G

WASHINGTON
Post-Pool Raise Spillway Prototype Test for Chief Joseph Dam Columbia River, Washington,
W87-09153 8A

Ellisford Cremations: Internecine Hostilities in the 5th Century A.D.,
W87-09162 6G

WASTE DISPOSAL
Attenuation of Cd and Pb Solubility in Municipal Waste Incinerator Ash,
W87-08776 5E

Managing Powerplant Combustion Wastes,
W87-08803 5E

Geologic Isolation of High-Level Radioactive Waste: Putting It Away Forever,
W87-08805 5E

Stochastic Modelling of a Contaminated Aquifer: The Unconditional Approach,
W87-08820 5B

Effect of Fertilization with Municipal Sludge on the Glutathione, Polyamine, and Cadmium Content of Cole Crops and Associated Loopers (Trichoplusia ni),
W87-08835 5C

Trees as Indicators of Subterranean Water Flow from a Retired Radioactive Waste Disposal Site,
W87-08845 5A

Effects of Distillery Waste on the Performance of Cicer arietinum L.,
W87-08873 5C

Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: I. Persistence, Yield, Quality, and Elemental Removal,
W87-08919 5C

Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: II. Rainfall Runoff and Soil Chemical Properties,
W87-08920 5C

Effect of Sewage Sludge on Soil Structural Stability: Microbiological Aspects,
W87-08997 5C

Development of a Simplified Column Test for Evaluation of Thickness of Capping Material Required to Isolate Contaminated Dredged Material,
W87-09091 5G

Establishment of Biotic Communities Within a Newly Constructed Ash Settling Basin and Its Drainage System,
W87-09323 5E

Basic Data Report for Drilling and Hydrologic Testing of Drillhole DOE-2 at the Waste Isolation Pilot Plant (WIPP) Site,
W87-09333 5E

Wastewater-Induced Soil Clogging Development,
W87-09373 5C

WASTE DISPOSAL

Evaluating Asphalt Cap Effectiveness at Superfund Site,
W87-09379 5E

Environmental Aspects of Energy Related Solid Waste,
W87-09427 5E

WASTE MANAGEMENT

Development Programs in the United States of America for the Application of Cement-Based Grouts in Radioactive Waste Management,
W87-09113 5E

Management of Industrial Pollutants by Anaerobic Processes,
W87-09190 5D

WASTE RECOVERY

Omaha Recycles Sludge in Agricultural Program,
W87-08808 5E

WASTE TREATMENT

Attenuation of Cd and Pb Solubility in Municipal Waste Incinerator Ash,
W87-08776 5E

Management of Industrial Pollutants by Anaerobic Processes,
W87-09190 5D

Methane Recovery from Water Hyacinth Through Whole-Cell Immobilization Technology,
W87-09420 5D

WASTEWATER

Heavy Metal Pollution of the Mid-Canal of Kandy: An Environmental Case Study from Sri Lanka,
W87-08840 5C

WASTEWATER ANALYSIS

Determination of Cobalt, Copper, Mercury, and Nickel as Bis(2-hydroxyethyl)dithiocarbamate Complexes by High-Performance Liquid Chromatography,
W87-08831 5A

Concentration of Giardia Cysts from Water by a Centrifugal Cream Separator,
W87-09209 5A

WASTEWATER DISPOSAL

Design and Use of Pressure Sewer Systems,
W87-09309 5D

Internal Hydraulics of Diffusers with Uniform Lateral Momentum Distribution,
W87-09366 8B

Wastewater-Induced Soil Clogging Development,
W87-09373 5C

WASTEWATER RATES

Factors Affecting Water and Wastewater Rates,
W87-09221 6C

WASTEWATER TRANSPORT

Design and Use of Pressure Sewer Systems,
W87-09309 5D

WASTEWATER TREATMENT

Recovery of Organics from Tailings Pond Sludge Using Coke for Agglomeration,
W87-08602 5D

Wastewater Treatment System Applying Aeration-Cavitation Flotation Mechanism,
W87-08603 5D

Removal of Traces of Pentachlorophenol from Aqueous Acidic Solutions by Solvent Extraction and Solvent Sublation,
W87-08605 5D

Separation of Mercury from Aqueous Mercuric Chloride Solutions by Onion Skins,
W87-08606 5D

Studies on Water Hyacinth as a Biological Filtre for Treating Contaminants from Agricultural Wastes and Industrial Effluents,
W87-08609 5D

Movement of Oligotrophic Bacteria in Activated Sludge,
W87-08771 5D

Biodegradation of Phenols in an Integrated Activated Carbon Bed and Suspended Aerobic Biological Growth Reactor,
W87-08774 5D

Puerto Rico Seeks Clean Water,
W87-08802 5D

Applications of Porous Membranes for Biomass Retention in Biological Wastewater Treatment Processes,
W87-08889 5D

Anaerobic Treatment of Distillery Slops Using an Upflow Anaerobic Filter Reactor,
W87-08890 5D

Biological Denitrification of a Highly Nitrogenous Industrial Effluent: A Case Study in Zimbabwe,
W87-08964 5D

Handbook of Chlorination,
W87-09064 5D

Applied Stream Sanitation,
W87-09189 2H

Economics of the Treatment of Dairy Cow Slurry by Anaerobic Digestion,
W87-09216 5D

Water Treatment: The States Zero in on Groundwater Regulation,
W87-09222 5F

Removal of Phenols by Adsorption on Fly Ash,
W87-09250 5D

Study of the Kinetics of the Adsorption by Activated Carbons of 2,4,5-Trichlorophenoxyacetic Acid from Aqueous Solution,
W87-09251 5D

Adsorption of 2,4,5-T by Active Carbons from Aqueous Solution,
W87-09254 5D

Biodegradability of para-Dichlorobenzene and Its Behaviour in Model Activated Sludge Plants,
W87-09269 5D

Enhanced Uptake of Phosphorus by Activated Sludge - Effect of Substrate Addition,
W87-09270 5D

Methanogenic Toxicity and Anaerobic Degradability of a Hydrolyzable Tannin,
W87-09278 5D

Desorption and Regeneration of Dye Colours from Low-Cost Materials,
W87-09279 5D

Biofilm Shearing Under Dynamic Conditions,
W87-09367 5D

Prediction of Fixed-Bed Adsorber Removal of Organics in Unknown Mixtures,
W87-09369 5D

Rational Design of Aerobic Digestion System,
W87-09370 5D

Expansion of Granular Filters During Backwashing,
W87-09371 5D

Comparison of Backwash Models for Granular Media,
W87-09372 5D

Modeling Coliform Bacteria Subject to Chlorination,
W87-09375 5D

Sediment Diffusion in Primary Shallow Rectangular Clarifiers,
W87-09376 5F

Potassium Ferrioxalate as Chemical Actinometer in Ultraviolet Reactors,
W87-09377 5F

Biodegradation of Trichloroethylene and Involvement of an Aromatic Biodegradative Pathway,
W87-09387 5D

Scale-Up of Water and Wastewater Treatment Processes.
W87-09431 5D

Scale-Up and Scale-Down Concepts and Problems,
W87-09432 5D

Introduction to Scale-Up of Water and Wastewater Treatment Processes,
W87-09433 5D

Perspectives on the Scale-Up of Impeller Mixers,
W87-09434 5D

Important Issues in the Scale Up of New Processes,
W87-09435 5D

Geometric Parameters and Efficiency of Diffused Air Systems,
W87-09437 5D

Significance of Oxygen Transfer Variables in the Sizing of Dome Diffuser Aeration Equipment,
W87-09438 5D

Optimization of Mechanical Aerators in a Hydraulic Two-Phase Flow Model and the Scale-Up of the Results for the Prototype,
W87-09439 5D

Scaling-Up Studies on Wastewater Sedimentation,
W87-09441 5D

Development of a New Type of Fluidized Bed Reactor,
W87-09444 5D

Scale-Up of Solid Bowl Centrifuges for Sludge Dewatering,
W87-09445 5E

Modeling for Process Scale-Up of Adsorption and Ion Exchange Systems,
W87-09446 5D

Scale-Up of a Radium-226 Removal Process,
W87-09448 5D

Relationship Between Bench Scale and Prototype Activated Sludge Systems,
W87-09449 5D

Role of Kinetic Models for the Scale-Up of Biological Processes,
W87-09450 5D

Scale-Up of Activated Sludge and Trickling Filter Processes,
W87-09451 5D

Efficiency and Process: Stability of Single Stage and Multi-Stage Wastewater Treatment Plants,
W87-09452 5D

Scale-Up of Biological Wastewater Treatment Processes: Practical Experiences in the U.K., W87-09453 5D

Development of a Competitive Two-Stage Biological Treatment System: Results of Pilot Plants and Full Scale Plants, W87-09454 5D

Scale-Up Experience with the Waterloo SCP Process in Industrial Biomass Waste Treatment, W87-09455 5D

Swine Lagoon Effluent Applied to Coastal Bermudagrass, W87-09472 5D

Ten Years of Saltmarsh Monitoring - The Case History of a Southampton Water Saltmarsh and a Changing Refinery Effluent Discharge, W87-09545 5C

WASTEWATER TREATMENT FACILITIES

Ammonia, Hydrogen Sulphide and Methyl Mercaptides in Finnish Municipal Sewage Plants and Pumping Stations, W87-08725 5D

WATBAL MODEL

WATBAL: A Semi-Distributed, Physically Based Hydrological Modelling System, W87-08823 2G

WATER ALLOCATION

Allocation Model for Irrigation Water Cost: Case Study of the Nile Valley in Egypt, W87-08968 6C

WATER ANALYSIS

Determination of Cobalt, Copper, Mercury, and Nickel as Bis(2-hydroxyethyl)dithiocarbamate Complexes by High-Performance Liquid Chromatography, W87-08831 5A

Determination of Trace Metals in a River Water Reference Material by Inductively Coupled Plasma Mass Spectrometry, W87-08832 5A

Spectrophotometric Determination of Traces of Silicon in Water after Collection as Silicomolybdenum Blue on an Organic-Solvent-Soluble Membrane Filter, W87-08833 5A

Heavy Metal Pollution of the Mid-Canal of Kandy: An Environmental Case Study from Sri Lanka, W87-08840 5C

Analysis of Pentachlorophenol in Water and Urine by Enrichment with Lipidex(R) 5000, W87-08896 5A

Seasonal Distribution of Legionellae Isolated from Various Types of Water in Israel, W87-08903 5A

Asbestos Fibres Introduce Trace Metals into Streamwater and Sediments, W87-08912 5B

Chemistry of Tension Lysimeter Water and Lateral Flow in Spruce and Hardwood Stands, W87-08926 5B

Accuracy of Selective Extraction Procedures for Metal Speciation in Model Aquatic Sediments, W87-08985 5A

Determination of Low Levels of Cationic Polyelectrolytes in Water, W87-08986 5A

Extraction of Humic Substances from Soil, W87-09079 7B

Isolation and Concentration Techniques for Aquatic Humic Substances, W87-09080 2H

Fractionation Techniques for Aquatic Humic Substances, W87-09082 7B

Analytical Methodology for Elemental Analysis of Humic Substances, W87-09083 7B

Implications of Elemental Characteristics of Humic Substances, W87-09084 7B

NBS Environmental Standard Reference Materials for Use in Validating Water Analysis, W87-09127 5A

Concentration of Giardia Cysts from Water by a Centrifugal Cream Separator, W87-09209 5A

Correlation of Some Organic Pollution Factors in Water Systems in Northern Greece, W87-09264 5B

Analytical Chemistry, W87-09295 5B

Comparison of the Hydrophobic-Grid Membrane Filter Procedure and Standard Methods for Coliform Analysis of Water, W87-09392 5A

Guidelines for Sampling and Analyzing Solutions from Aquifer Thermal-Energy-Storage Systems, W87-09457 5A

Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants, Part 1, W87-09462 5B

WATER BIRDS

Embryotoxicity, Teratogenicity, and Aryl Hydrocarbon Hydroxylase Activity in Forster's Terns on Green Bay, Lake Michigan, W87-08841 5C

WATER CHEMISTRY

Chemistry of the River Niger I. Major Ions, W87-08719 2K

Chemistry of the River Niger II. Trace Metals, W87-08720 2K

Improvement of Irrigation Water by Gypsum Beds, W87-08745 5G

Heavy Metals in Lake Kinneret (Israel): II. Hydrogen Sulfide Dependent Precipitation of Copper, Cadmium, Lead and Zinc, W87-08761 2H

Chemistry of Tension Lysimeter Water and Lateral Flow in Spruce and Hardwood Stands, W87-08926 5B

Principles of Aquatic Chemistry, W87-09305 2K

WATER CONSERVATION

Semiarid Soil and Water Conservation, W87-08661 3F

Agronomic Measures for Soil and Water Conservation, W87-08664 3F

Engineering Measures: Waterways and Diversion Channels, W87-08666 8A

Engineering Measures for Soil and Water Conservation: Terracing and Benching, W87-08667 3F

Engineering Measures: Water Harvesting, W87-08668 3F

Use of Canopy Temperatures to Identify Water Conservation in Cotton Germplasm, W87-08788 3F

Soil Water Evaporation Comparisons Among Tillage Practices in the Northern Great Plains, W87-09006 2D

Synthesis of a Simplified Water Use Simulation Model for Predicting Wheat Yields, W87-09028 2I

WATER CONVEYANCE

Epidemiological Evidence of Legionellosis Transmission through Domestic Hot Water Supply Systems and Possibilities of Control, W87-08905 5F

Handbook of Public Water Systems. W87-09063 5F

WATER COST

Allocation Model for Irrigation Water Cost: Case Study of the Nile Valley in Egypt, W87-08968 6C

WATER CURRENTS

Analysis of Horizontally Two-Dimensional Morphological Evolutions in Shallow Water, W87-08782 7C

Lateral Mixing in Channels Due to Secondary Currents, W87-08827 2E

Dynamics of Bottom Currents in a Small Lake, W87-08865 2H

WATER DEFICIT

Nitrogenase Activity, Photosynthesis and Nodule Water Potential in Soyabean Plants Experiencing Water Deprivation, W87-08798 2I

Leaf Thickness and Water Deficit in Plants: A Tool for Field Studies, W87-08847 2D

WATER DELIVERY

Production Functions for Water Delivery Systems: Analysis and Estimation Using Dual Cost Function and Implicit Price Specifications, W87-09014 6D

WATER DEMAND

Alternative Demand Model Estimators for Block Rate Pricing, W87-08984 6C

Metropolitan Water Management, W87-09338 6D

Low Freshwater Inflow Study: Chesapeake Bay Hydraulic Model Investigation, W87-09484 2L

WATER DISPOSAL

Physical and Chemical Behavior and Environmental Acceptability of Stabilized Scrubber Sludge and Fly Ash in Seawater, W87-09327 5B

WATER EXCHANGE

Modelling Water Exchange and Transit Times in Till Basins Using Oxygen-18, W87-08821 2A

WATER HARVESTING

Engineering Measures: Water Harvesting, W87-08668 3F

Linear Regression Model Combined with a Soil Water Balance Model to Design Micro-Catchments for Water Harvesting in Arid Zones, W87-08738 3B

WATER HYACINTH
Studies on Water Hyacinth as a Biological Filtre for Treating Contaminants from Agricultural Wastes and Industrial Effluents,
W87-08609 5D

Methane Recovery from Water Hyacinth Through Whole-Cell Immobilization Technology,
W87-09420 5D

WATER JETS
Coherent, Plunging Water Jets for Oil Spill Control,
W87-09565 5G

WATER LAW
Federal Protection of Groundwater,
W87-09129 5G

World Health Organization and Guidelines and European Economic Community Directives,
W87-09130 6E

Regulatory Flexibility and Consumer Options Under the Safe Drinking Water Act,
W87-09131 5F

WATER LEVEL
Defending Our LakeShores,
W87-08674 4D

Water Level Regulation of Lake Inari: Impacts and Compensation Measures,
W87-09053 2H

WATER LEVEL FLUCTUATIONS
Estimation of Groundwater Recharge in Sandy Till with Two Different Methods Using Groundwater Level Fluctuations,
W87-08615 2F

Ecological Consequences of Artificial Changes in the Water Regime of Lakes and Their Significance for Forecasting,
W87-08708 6G

Diffusivity of a Glacial-Outwash Aquifer by the Floodwave-Response Technique,
W87-08754 2F

Overtopping Risk for an Existing Dam,
W87-09461 8A

Information Retrieval System: Impacts of Water-Level Changes on Uses of Federal Storage Reservoirs of the Columbia River; Appendix F: RIVOPR User's Manual,
W87-09477 10B

WATER LEVELS
Predictive Application of an ORNL Geohydrology Model,
W87-08760 7C

WATER MANAGEMENT
Water Quality Beneath Urban Runoff Water Management Basins,
W87-08967 2F

Interactive Computer-Aided Water Resources and Environmental Planning Using Color Raster Graphics: Program Description and User's Guide,
W87-09426 7C

WATER POLLUTION
Stochastic Modelling of a Contaminated Aquifer: The Unconditional Approach,
W87-08820 5B

Adsorption of Inorganic Pollutants in Aquatic Systems,
W87-09194 5B

Correlation of Some Organic Pollution Factors in Water Systems in Northern Greece,
W87-09264 5B

WATER POLLUTION CONTROL
What Industry is Doing to Protect Aquatic Life,
W87-08628 5G

Attenuation of Cd and Pb Solubility in Municipal Waste Incinerator Ash,
W87-08776 5E

Velocity Control as a Tool for Optimal Plume Containment in the Equus Beds Aquifer, Kansas,
W87-08982 5G

Regulation of Contaminants In Drinking Water,
W87-09128 5F

Dependence of River Pollution on Streamflow Regulation by Reservoirs,
W87-09361 5G

Metal Precipitation in Two Landfill Leachates,
W87-09368 5G

Measurement of Water Potential in Low-Level Waste Management,
W87-09456 7B

Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants, Part 1,
W87-09462 5B

Dredged Material Containment in Long Island Sound (With Special Emphasis on Eastern New York Waters),
W87-09474 8A

WATER POLLUTION EFFECTS
Carcinogenic Effects in A/J Mice of Particulate of a Coal Tar Paint Used in Potable Water Systems,
W87-08613 5C

Hydrogen Sulfide Poisonings in Hot-Spring Reservoir Cleaning: Two Case Reports,
W87-08614 5C

Aquatic Toxicology and Hazard Assessment: Eighth Symposium.
W87-08624 6E

What Industry is Doing to Protect Aquatic Life,
W87-08628 5G

Research Needs for Rapid Assessments of Chronic Toxicity,
W87-08630 5C

Research Needs in Validating and Determining the Predictability of Laboratory Data to the Field,
W87-08631 5C

Multispecies Tests: Research Needs to Assess the Effects of Chemicals on Aquatic Life,
W87-08632 5A

Research Needs in Developing Structure Activity Relationships,
W87-08633 5C

Biological Effects of Continuous and Intermittent Dosing of Outdoor Experimental Streams with Chloropyrifos,
W87-08634 5C

Acclimation as a Factor Influencing Metal Criteria,
W87-08635 5C

New Approach for Regulating Iron in Water Quality Standards,
W87-08636 5G

Comparison of QSAR Predictions with Fish Toxicity Screening Data for 110 Phenols,
W87-08637 5C

Field Confirmation of a Laboratory-Derived Hazard Assessment of the Acute Toxicity of Fenthion to Pink Shrimp, Penaeus duorarum,
W87-08638 5C

Time/Toxicity Relationships in Short-Term Static, Dynamic, and Plug-Flow Bioassays,
W87-08639 5C

Acute Toxicity of Chlorine on Freshwater Organisms: Time-Concentration Relationships of Constant and Intermittent Exposures,
W87-08640 5C

Sensitivity of Chronic Endpoints Used in Daphnia Magna Straus Life-Cycle Tests,
W87-08642 5C

Aquatic Hazard Assessment: Picloram,
W87-08643 5C

Effects of Triethylene Glycol on Mysidopsis bahia (Crustacea: Mysidacea) and Menidia peninsulae (Pisces: Atherinidae),
W87-08644 5C

Interlaboratory Comparison of the ASTM Bioconcentration Test Method Using the Eastern Oyster,
W87-08645 5A

Harmonization of Biological Testing Methodology: A Performance-Based Approach,
W87-08646 5A

Toxicity of Aqueous Extracts of Natural and Synthetic Oils to Three Species of Lemna,
W87-08647 5C

Comparison of Techniques for Evaluating the Effect of Cadmium on Pseudomas Fluorescens,
W87-08648 5C

Measuring Fish Lengths from Instant Photographs Using a Digitizing Tablet and Minicomputer,
W87-08649 7B

Advantages of Using Regression Analysis to Calculate Results of Chronic Toxicity Tests,
W87-08650 5C

Effects of an Acidic River, Caused by Acidic Rain, on Weight Gain, Steroidogenesis, and Reproduction in the Atlantic Salmon (Salmo salar),
W87-08651 5C

Usefulness of the Lipid Index for Bioaccumulation Studies with Daphnia magna,
W87-08652 5C

Effects of Suspended Volcanic Ash and Thermal Shock on Susceptibility of Juvenile Salmonids to Disease,
W87-08653 5C

Appropriate Durations and Measures for Ceriodaphnia Toxicity Tests,
W87-08654 5C

Rapid Aquatic Toxicity Assay Using Incorporation of Tritiated-Thymidine into Sea Urchin, Arbacia punctulata, Embryo: Evaluation of Toxicant Exposure Procedures,
W87-08655 5C

Acute and Chronic Toxicity to the Fathead Minnow, Pimephales promelas, of Effluents from a Treatment Plant Receiving Dye and Pigment Processing Wastewater,
W87-08656 5C

Environmental Exposure from Chemicals.
W87-08670 5B

Environmental Systems Analysis: An Overview,
W87-08671 5B

Environmental Exposure from Chemicals.
W87-08675 5B

Outbreak of Legionnaires' Disease in Glasgow Royal Infirmary: Microbiological Aspects,
W87-08703 5C

Growth and Development of Rana arvalis in Conditions Imitating Oil Contamination,
W87-08713 5C

Use of Bullfrogs (Rana catesbeiana) as Biological Markers for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin Contamination in the Environment,
W87-08733 5A

Benthic Macroinvertebrates of the Meuse River in Belgium: A Review of Five Years of Research (1980-1984) (Les Macroinvertebres Benthiques de la Meuse Belge: Bilan de Cinq Annees de Recherches (1980 a 1984),
W87-08765 5C

Impact of Simulated Acidic Precipitation on Quantity and Quality of a Field Grown Potato Crop,
W87-08789 5C

Salinity During Embryonic Development Influences the Response to Salinity of Gasterosteus Aculeatus L. (Trachurus),
W87-08793 2H

Effect of Fertilization with Municipal Sludge on the Glutathione, Polyamine, and Cadmium Content of Cole Crops and Associated Loopers (Trichoplusia ni),
W87-08835 5C

Heavy Metal Pollution of the Mid-Canal of Kandy: An Environmental Case Study from Sri Lanka,
W87-08840 5C

Embryotoxicity, Teratogenicity, and Aryl Hydrocarbon Hydroxylase Activity in Forster's Terns on Green Bay, Lake Michigan,
W87-08841 5C

Effect of Ingested Benzo(a)pyrene and Cadmium on Tissue Accumulation, Hydroxylase Activity, and Intestinal Morphology of the Black Sea Bass, Centropristis striata,
W87-08842 5C

In Vitro Cytotoxicity of Organic Pollutants to Bluegill Sunfish (BF-2) Cells,
W87-08843 5C

Age-Dependent Lung Doses from Ingested 222Rn in Drinking Water,
W87-08844 5C

Lead Nitrate Induced Changes in the Thyroid Physiology of the Catfish Clarias batrachus (L),
W87-08850 5C

Impact of Pesticides on Lipid Metabolism in the Freshwater Catfish, Clarias batrachus, during the Vitellogenic Phase of Its Annual Reproductive Cycle,
W87-08851 5C

Xenobiotic-Metabolizing Enzyme Systems in Test Fish: I. Comparative Studies of Liver Microsomal Monooxygenases,
W87-08852 5C

Limits of Bioaccumulation of Organic Pigments in Fish: Their Relation to the Partition Coefficient and the Solubility in Water and Octanol,
W87-08853 5B

Long-Term Effects of Bleached Kraft Mill Effluents on Carbohydrate Metabolism and Hepatic Xenobiotic Biotransformation Enzymes in Fish,
W87-08854 5C

Quantitative and Qualitative Aspects of Fish Crop in Relation to Environmental Quality,
W87-08855 5C

Influence of Cadmium Exposure on Selected Hematological Parameters in Freshwater Teleost, Notemigonus crysoleucas,
W87-08857 5C

Pesticide-Induced Changes in Peripheral Thyroid Hormone Levels during Different Reproductive Phases in Heteropneustes fossilis,
W87-08858 5C

Comparative Metabolism of Fenitrothion in Aquatic Organisms: I. Metabolism in the Euryhaline Fish, Oryzias latipes and Mugil cephalus,
W87-08859 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: II. Metabolism in the Freshwater Snails, Cipangopaludina japonica and Physa acuta,
W87-08860 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: III. Metabolism in the Crustaceans, Daphnia pulex and Palaemon paucidens,
W87-08861 5B

Effects of Distillery Waste on the Performance of Cicer arietinum L.,
W87-08873 5C

Effect of Polluted and Leached Snow Melt Waters on the Soil Bacterial Community--Quantitative Response,
W87-08874 5C

Acute Toxicity of Brestan and Fentin Acetate on Some Freshwater Organisms,
W87-08876 5C

Toxicity of Picloram (4-Amino-3,5,6-Trichloropicolinic Acid) to Life Stages of the Rainbow Trout,
W87-08877 5C

Growth of Mixed Microbial Populations in Ground Water Containing Highly Chlorinated Organic Wastes,
W87-08878 5B

Effects of Lowered Dissolved Oxygen Concentration on the Toxicity of 1,2,4-Trichlorobenzene to Fathead Minnows,
W87-08879 5C

Acute Toxicity of Emulsifiable Concentrations of Three Insecticides Commonly Found in Nonpoint Source Runoff into Estuarine Waters to the Mummichog, Fundulus heteroclitus,
W87-08881 5C

Cadmium Contamination in American Lobster, Homarus americanus, Near a Coastal Lead Smelter: Use of Multiple Linear Regression for Management,
W87-08882 5C

Cadmium and Lead in Lake Ontario Salmonids,
W87-08883 2H

Correlation between Heavy Metal Acute Toxicity Values in Daphnia magna and Fish,
W87-08887 5A

Dynamics of Nitrogen and Carbon in Soil during Papermill Sludge Decomposition,
W87-08891 5E

Effect of Irrigation on Persistent Toxicity of Insecticides Applied as Granules to Soil to Brown Plant Hopper and Rice Swarming Caterpillar,
W87-08897 5B

Impact-Sensitiveness of Soil Oribatid Species to the Waste Water from a Coal Distillation Plant,
W87-08898 5A

Effect of Mosquito Killer Insecticides on Freshwater Mussels,
W87-08908 5C

Contamination of Fish from the French Zone of Lake Leman by Organochlorine Compounds between 1973 and 1981 (Contamination des Poissons du Secteur Francais du Lac Leman, par les Composes Organochlores entre 1973 et 1981),
W87-08909 2H

Fate of 14C-Lindane in a Rice-Fish Model Ecosystem,
W87-08915 5B

Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: I. Persistence, Yield, Quality, and Elemental Removal,
W87-08919 5C

Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: II. Rainfall Runoff and Soil Chemical Properties,
W87-08920 5C

Residual Effects of Sewage Sludge on Soybean: I. Accumulation of Heavy Metals,
W87-08921 5C

Residual Effects of Sewage Sludge on Soybean: II. Accumulation of Soil and Symbiotically Fixed Nitrogen,
W87-08922 5C

Soybean Growth and Boron Distribution in a Sandy Soil Amended with Scrubber Sludge,
W87-08927 5C

Soil Clogging During Subsurface Wastewater Infiltration as Affected by Effluent Composition and Loading Rate,
W87-08928 5C

Comparative Effects of Mine Wastes on the Benthos of an Acid and an Alkaline Pond,
W87-08962 5C

Effects of Low Ambient pH on Perivitelline Fluid of Ambystoma maculatum (Shaw) Eggs,
W87-08963 5C

Factors Influencing Acute Toxicity of Coal Ash to Rainbow Trout (Salmo gairdneri) and Bluegill Sunfish (Lepomis macrochirus),
W87-08978 5C

Effect of Sewage Sludge on Soil Structural Stability: Microbiological Aspects,
W87-08997 5C

Chemical Contaminants in Bottomfish,
W87-09035 5B

Mathematical Study of the Impact on Salinity Intrusion of Deepening the Lower Mississippi River Navigation Channel,
W87-09095 5B

Comparative Toxicity of SRC-I Wastewater to Aquatic Organisms,
W87-09106 5C

Report of the Acid Rain Peer Review Panel.
W87-09107 5B

Safe Drinking Water: The Impact of Chemicals on a Limited Resource.
W87-09114 5C

Chemicals and Safe Drinking Water: National and International Perspective,
W87-09115 5C

Drinking Water: A Global Victual,
W87-09116 5C

Public Drinking Water and Chemicals,
W87-09117 5C

American West's Acid Rain Test,
W87-09160 5B

Importance of Atmospheric Fluxes to the Nitrogen Balance of Lakes in the Florida Peninsula,
W87-09176 2H

Atmospheric Deposition of Acidity and Sulfur in Florida,
W87-09177 5B

Lichens as Monitors of Atmospheric Deposition,
W87-09181 5C

Use of Bog Vegetation as a Monitor of Atmospheric Input of Metals,
W87-09182 5C

Perennial Pasture Production after Irrigation with Saline Groundwater in the Goulburn Valley, Victoria,
W87-09208 3C

Public Health Significance of Industrial Pollution in Zaria, Nigeria,
W87-09226 5B

Freshly Prepared Rat Hepatocytes Used in Screening the Toxicity of Blue-Green Algal Blooms,
W87-09230 5A

Influence of Simulated Acidic Rain on Vegetative and Reproductive Tissues of Cucumber (Cucumis sativus L.),
W87-09232 5C

Lethal Effects of Diquat and Paraquat on Developing Frog Embryos and 15-Day-Old Tadpoles, Rana pipiens,
W87-09235 5C

Toxic Effects of Organic Solvents on the Growth of Blue-Green Algae,
W87-09236 5C

Feeding Reduction and Recovery in Cunner Tautogolabrus adspersus Following Exposure to Crude Oil,
W87-09239 5C

Toxicity and Bioaccumulation of Cadmium in Experimental Cultures of Duckweed, Lemna polyrrhiza L.,
W87-09241 5C

Influence of Light on Chlorophyll, a Content of Blue-Green Algae Treated with Heavy Metals,
W87-09242 5C

Zinc, Iron, Manganese, and Magnesium Accumulation in Crayfish Populations Near Copper - Nickel Smelters at Sudbury, Ontario, Canada,
W87-09243 5C

Safety Factor for LC50 Values Allowing for Differences in Sensitivity Among Species,
W87-09266 5C

Comparison of Toxicity Tests Conducted in the Laboratory and in Experimental Ponds using Cadmium and the Fathead Minnow (Pimephales promelas),
W87-09272 5C

Fundamentals of Aquatic Toxicology: Methods and Applications.
W87-09280 5C

Acute Toxicity Tests,
W87-09281 5C

Early Life Stage Toxicity Tests,
W87-09282 5C

Chronic Toxicity Tests,
W87-09283 5C

Statistical Analysis,
W87-09284 5C

Factors that Modify Toxicity,
W87-09285 5C

Toxicity of Chemical Mixtures,
W87-09286 5C

Microbial Toxicity Studies,
W87-09287 5C

Behavior,
W87-09288 5C

Histopathology,
W87-09290 5C

Pesticides,
W87-09291 5C

Trace Metals,
W87-09292 5C

Polycyclic Aromatic Hydrocarbons,
W87-09293 5C

Ammonia, Nitrite, and Nitrate,
W87-09294 5C

Bioaccumulation,
W87-09296 5B

Biotransformation,
W87-09297 5B

Fate Modeling,
W87-09298 5B

Field Validation,
W87-09300 7A

Chemical Safety Evaluation,
W87-09301 5B

Response of Marine Animals to Petroleum and Specific Petroleum Hydrocarbons,
W87-09308 5C

Septic Tank System Effects on Ground Water Quality,
W87-09310 5C

Ecological Assessments of Effluent Impacts on Communities of Indigenous Aquatic Organisms.
W87-09311 5C

Evaluation of the Effects of Effluents on Aquatic Life in Receiving Waters - An Overview,
W87-09312 5C

Environmental Impact Analysis of Aquatic Ecosystems Using Rational Threshold Value Methodologies,
W87-09313 5C

Application of Laboratory Scale Model Streams Toward Assessing Effluent Impacts in Freshwater Lotic Environments,
W87-09314 5C

Ecological Factors in the Selection of Representative Species for Thermal Effluent Demonstrations,
W87-09315 5C

Power-Plant-Related Estuarine Zooplankton Studies,
W87-09316 5C

Method for Evaluating the Impact of Radioactivity on Phytoplankton,
W87-09317 5C

Effects of Copper on the Periphyton of a Small Calcareous Stream,
W87-09318 5C

Assessment of Effluent Impacts through Evaluation of Periphyton Diatom Community Structure,
W87-09320 5C

Effects of Exposure Time, Season, Substrate Type, and Planktonic Populations on the Taxonomic Composition of Algal Periphyton on Artificial Substrates in the Ohio and Little Miami Rivers, Ohio,
W87-09321 5C

Impact of Trinitrotoluene Wastewaters on Aquatic Biota in Lake Chickamauga, Tennessee,
W87-09322 5C

Establishment of Biotic Communities Within a Newly Constructed Ash Settling Basin and Its Drainage System,
W87-09323 5E

Assessment and Prediction of Impacts of Effluents on Communities of Benthic Stream Macroinvertebrates,
W87-09324 5C

Annual Macroinvertebrate Sampling - A Low-Cost Tool for Ecological Assessment of Effluent Impact,
W87-09325 5C

Use of Asiatic Clam Larvae in Aquatic Hazard Evaluations,
W87-09326 5C

Physical and Chemical Behavior and Environmental Acceptability of Stabilized Scrubber Sludge and Fly Ash in Seawater,
W87-09327 5B

Wastewater-Induced Soil Clogging Development,
W87-09373 5C

Effects of Intermittent Exposure to Suspended Solids and Turbulence on Three Species of Freshwater Mussels,
W87-09381 6G

Induction of Siderophore Activity in Anabaena spp. and Its Moderation of Copper Toxicity,
W87-09386 5G

Multiyear Study of Sludge Application to Farmland: Prevalence of Bacterial Enteric Pathogens and Antibody Status of Farm Families,
W87-09394 5C

Absence of Mutagenic and Antimutagenic Activities of Fluoride in Ames Salmonella Assays,
W87-09405 5C

Effects of Simulated Acidic Mist on Germination of Alternaria solani and Phytophthora infestans in vitro and their Infection Efficiency and Sporulation on Potato,
W87-09414 5C

Yield Reductions in Winter Barley Grown on a Range of Soils and Exposed to Simulated Acid Rain,
W87-09416 5C

Effects of Pollution by Organic Sugar Mill Effluent on the Macro-invertebrates of a Stream in Tropical Queensland, Australia,
W87-09421 5C

Ecohydrodynamics and Simulation: Some Relevant Problems of Scale-Up and -Down,
W87-09436 5C

1984 Annual Report to the President and Congress: National Acid Precipitation Assessment Program.
W87-09479 5B

WATER POLLUTION EFFETS
Biochemistry/Physiology,
W87-09289 5C

WATER POLLUTION PREVENTION
Determining Optimum Pumping Rates for Creation of Hydraulic Barriers to Ground-Water Pollutant Migration,
W87-09108 5G

Federal Protection of Groundwater,
W87-09129 5G

Ground Water Pollution Control,
W87-09150 5G

Suppression of Phosphate Liberation from Sediment by Using Iron Slag,
W87-09273 5G

WATER POLLUTION SOURCES
Carcinogenic Effects in A/J Mice of Particulate of a Coal Tar Paint Used in Potable Water Systems,
W87-08613 5C

Nonpoint Source Pollution Models for Chemicals,
W87-08673 5B

Some Metals and Their Possible Sources in Rain Water of the Southern Baltic Coast, 1976 and 1978-1980,
W87-08726 5B

Quantities of Cadmium, Lead, Mercury and Arsenic Entering the U.K. Environment from Human Activities,
W87-08728 5B

Leaching Losses from Irrigated Pasture: Waiau Irrigation Scheme, North Canterbury,
W87-08737 5B

Effect of Upland Pasture Improvement on Nutrient Release in Flows from a 'Natural' Lysimeter and a Field Drain,
W87-08741 5G

Profiles of Nitrogen Species in a Sand-Silt Aquifer at Haslemoen, Solor, South Norway,
W87-08818 5B

Use of the Pocketbook Mussel, Lampsilis ventricosa, for Monitoring Heavy Metal Pollution in an Ozark Stream,
W87-08875 5A

Seasonality of Legionella Isolates from Environmental Sources,
W87-08902 2H

Residues of Organochlorine Pesticides in Environmental Samples from the Shatt-al-Arab River, Iraq,
W87-08910 5B

Asbestos Fibres Introduce Trace Metals into Streamwater and Sediments,
W87-08912 5B

Analysis of the Impact of the Sudbury Smelters on Wet and Dry Deposition in Ontario,
W87-08942 5B

Water Quality Beneath Urban Runoff Water Management Basins,
W87-08967 2F

Geographic Information System to Predict Non-Point Source Pollution Potential,
W87-08977 7A

Groundwater-Leachate: Modeling/Monitoring/Sampling,
W87-09089 5B

Formation of Toxaphene-Like Contaminants During Simulated Paper Pulp Bleaching,
W87-09093 5B

Quality of Urban Runoff,
W87-09102 5B

Report of the Acid Rain Peer Review Panel.
W87-09107 5B

Safe Drinking Water: The Impact of Chemicals on a Limited Resource.
W87-09114 5C

Public Drinking Water and Chemicals,
W87-09117 5C

Occurence of Contamination In Drinking Water From Groundwater Sources,
W87-09125 5B

Improved Monitoring Techniques to Assess Groundwater Quality Near Sources of Contamination,
W87-09126 5A

American West's Acid Rain Test,
W87-09160 5B

Atmospheric Pollutants in Natural Waters.
W87-09164 5B

Modeling of Atmospheric Wet Deposition,
W87-09165 5B

Modeling of Atmospheric Particulate Deposition to Natural Waters,
W87-09166 5B

Input of Biologically Available Phosphorus by Precipitation to Precambrian Lakes,
W87-09174 5B

Atmospheric Deposition of Nitrogen and Phosphorus in Florida,
W87-09175 5B

Atmospheric Deposition of Acidity and Sulfur in Florida,
W87-09177 5B

Atmospheric Lead and Zinc Deposition into Lakes of the Eastern United States,
W87-09183 5B

Inputs of Polychlorinated Biphenyls from the Atmosphere to Lakes Huron and Michigan,
W87-09186 5B

Atmospheric Deposition of Particulate Organic Carbon and Polyaromatic Hydrocarbons to Lake Michigan,
W87-09187 5B

Aerial Deposition of Organochlorines in Urban and Coastal South Carolina,
W87-09188 5B

Impact of Agriculture on Surface Water in Ireland: Part I. General,
W87-09199 5B

Impact of Agriculture on Surface Water in Ireland: Part II. Prospects for the Future,
W87-09200 4C

Heavy Metals Distribution in the Sediments of Ganges and Brahmaputra Rivers,
W87-09204 5B

Nonpoint Agricultural Pollution: Pesticide Contamination of Groundwater Supplies,
W87-09213 5B

Public Health Significance of Industrial Pollution in Zaria, Nigeria,
W87-09226 5B

Characterization of the PAC Profile in Settling Particulates from the Urban Waters of Stockholm,
W87-09237 5B

Response of Lake Sediments to Changes in Trace Metal Emission from the Smelters at Sudbury, Ontario,
W87-09245 5B

Trihalomethane Formation in Whirlpool Spas,
W87-09276 5B

Polycyclic Aromatic Hydrocarbons,
W87-09293 5C

Environmental Aspects of Energy Related Solid Waste,
W87-09427 5E

Leaching Behaviors of Low-Sulfur Coals and Coal Wastes from Three Western Coal Preparation Plants,
W87-09429 5B

1984 Annual Report to the President and Congress: National Acid Precipitation Assessment Program.
W87-09479 5B

Water-Quality Monitoring at the Hoe Creek Test Site: Review and Preliminary Conclusions,
W87-09495 5B

Processes Affecting the Distribution of Low-Molecular-Weight Aliphatic Hydrocarbons in Cook Inlet, Alaska,
W87-09506 5B

Hydrogeologic Factors that May Affect Mine Drainage in the Anthracite Region of Pennsylvania, Eastern United States,
W87-09577 4C

WATER POLLUTION TREATMENT
Hydraulic/Chemical Changes During Ground-Water Recharge by Injection,
W87-08751 5B

Photolytic Ozonation for Protection and Rehabilitation of Ground-Water Resources; A Mechanistic Study,
W87-09092 5G

Ground Water Pollution Control,
W87-09150 5G

Suppression of Phosphate Liberation from Sediment by Using Iron Slag,
W87-09273 5G

Petroleum Spills in the Marine Environment: The Chemistry and Formation of Water-in-Oil Emulsions and Tar Balls,
W87-09339 5B

Metal Precipitation in Two Landfill Leachates,
W87-09368 5G

WATER POTENTIALS
Field Water Relations of a Compass Plant, Lactuca serriola L.,
W87-08772 2I

Leaf Thickness and Water Deficit in Plants: A Tool for Field Studies,
W87-08847 2D

Physiological Responses to Drought of Lolium perenne L.: Measurement of, and Genetic Variation in, Water Potential, Solute Potential, Elasticity and Cell Hydration,
W87-08848 2D

Responses of Leaf Water Potential and Leaf Diffusive Resistance to Abscisic Acid, Water Stress and Low Temperature in Hibiscus escu-

lentus: The Effect of Water Stress and ABA Pre-Treatments,
W87-09210 2D

Water Relations of Xeric Grasses in the Field: Interactions of Mycorrhizzas and Competition,
W87-09341 2I

Changes at Panicle Emergence in the Water Relations of a Wetland and a Dryland Japonica Rice Cultivar Under Wetland Conditions,
W87-09415 2I

Leaf Photosynthesis and Conductance of Selected Triticum Species at Different Water Potentials,
W87-09419 2I

Measurement of Water Potential in Low-Level Waste Management,
W87-09456 7B

WATER QUALITY

Bacteriological Quality of Drinks From Vending Machines,
W87-08704 5F

Improvement of Irrigation Water by Gypsum Beds,
W87-08745 5G

Water-Quality Trends in the Nation's Rivers,
W87-08779 5G

Committee Report: Microbiological Considerations for Drinking Water Regulation Revisions,
W87-08959 5F

Water Quality Beneath Urban Runoff Water Management Basins,
W87-08967 2F

Exploring Existence Value,
W87-09031 6C

Estimating the Value of Water Quality Improvements in a Recreational Demand Framework,
W87-09033 6C

Quality of Urban Runoff,
W87-09102 5B

Data Collection and Instrumentation,
W87-09103 7B

Disinfectant Chemistry In Drinking Water - Overview of Impacts on Drinking Water Quality,
W87-09122 5F

Removal of Color from Drinking Water with Ozone,
W87-09138 5F

Chemistry of Natural Waters,
W87-09149 2K

Effect of Beaver Ponds on the Nonpoint Source Water Quality of a Stream in Southwestern Wyoming,
W87-09265 2H

Application of Laboratory Scale Model Streams Toward Assessing Effluent Impacts in Freshwater Lotic Environments,
W87-09314 5C

Statistical Techniques for Evaluating Procedures and Results for Periphyton Sampling,
W87-09319 7C

Role of Electrofishing in Assessing Environmental Quality of the Wabash River,
W87-09328 5A

Seasonal Effects on Ground-Water Chemistry of the Ouachita Mountains,
W87-09428 2K

LLNL Groundwater Quality: Sampling of Seven Shallow Wells on the LLNL Site,
W87-09458 5B

Orientation Study of St. Francois Mountain and Decaturville Precambrian Areas, Missouri,
W87-09459 2K

Influence of Meltwater on the Amount and Composition of Groundwater in Quaternary Deposits in Finland,
W87-09460 2F

Evaluation of the Model CE-QUAL-R1 for Use by the Aquatic Plant Control Research Program,
W87-09486 5B

Developments in LARM2: A Longitudinal-Vertical, Time-Varying Hydrodynamic Reservoir Model,
W87-09489 8B

Stream Water Quality in the Coal Region of Virginia,
W87-09494 4C

Hydrogeologic Factors that May Affect Mine Drainage in the Anthracite Region of Pennsylvania, Eastern United States,
W87-09577 4C

WATER QUALITY ASSESSMENT

Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants, Part 1,
W87-09462 5B

WATER QUALITY CONTROL

Clean Water Act Update: A New Role for Toxicology,
W87-08627 6E

Water Quality Criteria: Protection of Use Perspective,
W87-08629 5G

New Approach for Regulating Iron in Water Quality Standards,
W87-08636 5G

Effect of Upland Pasture Improvement on Nutrient Release in Flows from a 'Natural' Lysimeter and a Field Drain,
W87-08741 5G

Hydraulic/Chemical Changes During Ground-Water Recharge by Injection,
W87-08751 5B

Velocity Control as a Tool for Optimal Plume Containment in the Equus Beds Aquifer, Kansas,
W87-08982 5G

Multiattribute Analysis of the Impact on Society of Phosphorus Abatement Measures,
W87-09013 5G

Restoration of the River Vaikkojoki, Finland,
W87-09046 2H

Development of a Simplified Column Test for Evaluation of Thickness of Capping Material Required to Isolate Contaminated Dredged Material,
W87-09091 5G

Photolytic Ozonation for Protection and Rehabilitation of Ground-Water Resources; A Mechanistic Study,
W87-09092 5G

Improved Monitoring Techniques to Assess Groundwater Quality Near Sources of Contamination,
W87-09126 5A

Regulation of Contaminants In Drinking Water,
W87-09128 5F

Federal Protection of Groundwater,
W87-09129 5G

Structure and Regulation of the European Bottled Water Industry,
W87-09132 5F

Congressional Initiatives,
W87-09133 5G

Control of Tastes and Odors in Drinking Water with Ozone,
W87-09137 5F

Ground Water Pollution Control,
W87-09150 5G

Effluent Evaluation,
W87-09302 5A

Instrumentation for Environmental Monitoring, Volume 2: Water,
W87-09303 5A

Ecological Factors in the Selection of Representative Species for Thermal Effluent Demonstrations,
W87-09315 5C

Annual Macroinvertebrate Sampling - A Low-Cost Tool for Ecological Assessment of Effluent Impact,
W87-09325 5C

Investigation and Discussion of Techniques for Hypolimnion Aeration/Oxygenation,
W87-09481 5G

Protection of the Karstic Springs System in Golubinka Against Contamination by the Sea Water (la Protection du Systeme des Sources Karstiques de Golubinka Contre la Contamination par la Mer),
W87-09582 4B

WATER QUALITY EFFECT

Geochemistry, Soils and Cardiovascular Diseases,
W87-08692 2F

WATER QUALITY EFFECTS

Possible Influence of the Components of the Soil and Lithosphere on the Development and Growth of Neoplasms,
W87-08693 2K

Epidemiology of Dental Caries in Relation to Environmental Trace Elements,
W87-08694 5C

WATER QUALITY MANAGEMENT

Congressional Initiatives,
W87-09133 5G

Irrigated Agriculture and Groundwater Quality--A Framework for Policy Development,
W87-09212 6A

Dependence of River Pollution on Streamflow Regulation by Reservoirs,
W87-09361 5G

Limnological Investigations: Lake Koocanusa, Montana; Part 3: Basic Data, Post-Impoundment, 1972-1978,
W87-09463 2H

WATER QUALITY STANDARDS

Age-Dependent Lung Doses from Ingested 222Rn in Drinking Water,
W87-08844 5C

Effective Alternative to Official Regulation of Indirect Additives to Drinking Water,
W87-09120 5F

Water Treatment Chemicals Codex,
W87-09121 5F

Regulation of Contaminants In Drinking Water,
W87-09128 5F

World Health Organization and Guidelines and European Economic Community Directives,
W87-09130 6E

Regulatory Flexibility and Consumer Options Under the Safe Drinking Water Act,
W87-09131 5F

Structure and Regulation of the European Bottled Water Industry,
W87-09132 5F

WATER RATES

Regulatory Dilemmas Ensnare Arizona's Small Water Companies,
W87-08952 5F

Applying Economic Principles to Small Water Systems,
W87-08955 6C

Alternative Demand Model Estimators for Block Rate Pricing,
W87-08984 6C

Factors Affecting Water and Wastewater Rates,
W87-09221 6C

WATER RELATIONS

Water Relations of Xeric Grasses in the Field: Interactions of Mycorrhizzas and Competition,
W87-09341 2I

Water Vapor Uptake and Photosynthesis of Lichens: Performance Differences in Species with Green and Blue-Green Algae as Phycobionts,
W87-09345 2I

Effects of Water Stress on Gas Exchange and Water Relations of Succulent Epiphyte, Kalanchoe Uniflora,
W87-09347 2I

WATER RESOURCES AUDIT

Water Resources Audit for Small Communities,
W87-08953 5F

WATER RESOURCES DEVELOPMENT

Proposals for Agricultural Development of Wadi Dhuleil Catchment, Jordan,
W87-08739 3F

Estimating Water Table Contribution to the Water Supply of Maize,
W87-08740 3F

Effects on Fisheries of Non-Biotic Modifications of the Environment in the East-Danube River Area,
W87-09038 6G

Fall of Migratory Fish Populations and Changes in Commercial Fisheries in Impounded Rivers in Poland,
W87-09039 6G

Effects of Impoundment and Regulation of the River Tees at Cow Green (Northern Pennines, UK) Upon Fish Populations in Afferent Tributaries and in the River Immediately Downstream of the Dam,
W87-09040 6G

Adverse Effects of Channelization and Their Amelioration,
W87-09043 6G

Effects on Salmonid Populations of Isolation of a Lake From a River System,
W87-09051 6G

Development of Fish Stock and Fish Populations in Lake Inari,
W87-09054 2H

Food of Whitefish (Coregonus lavaretus) in Two Neighbouring Lakes, One Regulated and the Other Natural,
W87-09055 2H

Groundwater Resource Development,
W87-09148 6D

History of the Carlsbad Basin, Southeastern New Mexico,
W87-09151 6G

Preventing Desert Mule Deer Drownings in the Mohawk Canal, Arizona,
W87-09152 6G

Pecos Past: The Prehistory and History of the Brantley Project Locality,
W87-09155 6G

Coolidge Dam: Photographs Written Historical and Descriptive Data Reduced Copies of Drawings,
W87-09163 8A

Prehistoric Cultural Resources Study Predictive Model and Field Survey Weber Basin Project,
W87-09335 6G

Future Trends in Hydropower Development in China,
W87-09407 8A

Archaeological and Historical Surveys of Selected Portions of the Umatilla Basin Project, Umatilla County, Oregon,
W87-09425 6G

Interactive Computer-Aided Water Resources and Environmental Planning Using Color Raster Graphics: Program Description and User's Guide,
W87-09426 7C

WATER REUSE

Hydraulic/Chemical Changes During Ground-Water Recharge by Injection,
W87-08751 5B

WATER SAMPLING

Sampling and Composition of the Surface Microlayer,
W87-09173 5A

WATER STORAGE

Giant Water Tank Rises in Austin,
W87-08801 5F

WATER STRESS

Effects of Water Stress on Flowering and Fruit Set in Processing-Tomatoes,
W87-08770 2I

Use of Canopy Temperatures to Identify Water Conservation in Cotton Germplasm,
W87-08788 3F

Nitrogenase Activity, Photosynthesis and Nodule Water Potential in Soyabean Plants Experiencing Water Deprivation,
W87-08798 2I

Spring Wheat Growth at High and Low Soil Water with Constricted Upper Roots,
W87-08893 2D

Responses of Leaf Water Potential and Leaf Diffusive Resistance to Abscisic Acid, Water Stress and Low Temperature in Hibiscus esculentus: The Effect of Water Stress and ABA Pre-Treatments,
W87-09210 2D

Interaction of Euonymus scale (Homoptera:Diaspididae) Feeding Damage and Severe Water Stress on Leaff Abscission and Growth of Euonymus Fortunei,
W87-09344 2I

Effects of Water Stress on Gas Exchange and Water Relations of Succulent Epiphyte, Kalanchoe Uniflora,
W87-09347 2I

Impact of Irrigation and Experimental Drought Stress on Leaf-Mining Insects of Emory Oak,
W87-09402 2I

Glutathione Status and Protein Synthesis During Drought and Subsequent Rehydration in Tortula ruralis,
W87-09417 2I

Leaf Photosynthesis and Conductance of Selected Triticum Species at Different Water Potentials,
W87-09419 2I

Simulation Model for Predicting Effect of Water Stress on Yield: An Example Using Corn,
W87-09470 3F

WATER SUPPLY

Epidemiology of Dental Caries in Relation to Environmental Trace Elements,
W87-08694 5C

Water Use and Health in Mueda, Mozambique,
W87-08777 5F

Knowledge Attitudes and Practices in Relation to Schistosomiasis in a Rural Community,
W87-08778 5F

Presence of Legionella in London's Water Supplies,
W87-08901 5F

Innovative State Policies for Aiding Community Water Suppliers,
W87-08951 5F

Regulatory Dilemmas Ensnare Arizona's Small Water Companies,
W87-08952 5F

Water Resources Audit for Small Communities,
W87-08953 5F

Curbing THMs in Small Water Systems,
W87-08954 5F

Applying Economic Principles to Small Water Systems,
W87-08955 6C

Occurrence, Significance, and Detection of Klebsiella in Water Systems,
W87-08958 5A

Relationship Between Water-System Size and 222Rn Concentration in North Carolina Public Water Supplies,
W87-09218 5F

Effects of Storage Reallocation on Thermal Characteristics of Cowanesque Lake, Pennsylvania: Numerical Model Investigation,
W87-09485 2H

WATER SURFACE PROFILES

Exchange of Particles and Gases Across Water Surfaces,
W87-09168 5B

Mechanisms of Enrichment at the Air-Water Interface,
W87-09169 5B

Sampling and Composition of the Surface Microlayer,
W87-09173 5A

WATER TABLE

Groundwater Recharge and Discharge Response to Rainfall on a Hillslope,
W87-08706 2F

WATER TABLE

Estimating Water Table Contribution to the Water Supply of Maize,
W87-08740 3F

Influence of Underground Engineering Works on Hydrogeological Conditions of the Suburban Areas,
W87-09581 2F

Piezometric Level in Fissure Areas (Le Niveau Piezometrique dans les Zones de Diaclases),
W87-09601 2F

WATER TABLE FLUCTUATIONS

Gravity Drainage Analysis for Scale Heterogeneous Porous Materials Under Falling Water Table Conditions,
W87-09020 2G

WATER TANKS

Giant Water Tank Rises in Austin,
W87-08801 5F

WATER TEMPERATURE

Temperature and Flow Conditions in a Reservoir with a Submerged Outlet Tunnel During the Winter Period,
W87-08828 2H

Effects of Storage Reallocation on Thermal Characteristics of Cowanesque Lake, Pennsylvania: Numerical Model Investigation,
W87-09485 2H

WATER TREATMENT

Removal of Antimony from Aqueous Systems,
W87-08604 5F

Separation of Mercury from Aqueous Mercuric Chloride Solutions by Onion Skins,
W87-08606 5D

Improvement of Irrigation Water by Gypsum Beds,
W87-08745 5G

Cooperative Solution for a Water System 'Emergency',
W87-08807 5F

Biocidal Control of Legionellae,
W87-08904 5F

Epidemiological Evidence of Legionellosis Transmission through Domestic Hot Water Supply Systems and Possibilities of Control,
W87-08905 5F

Curbing THMs in Small Water Systems,
W87-08954 5F

Air-Water Phase Equilibria of Volatile Organic Solutes,
W87-08956 5F

Operational Variables and the Release of Colonized Granular Activated Carbon Particles in Drinking Water,
W87-08957 5F

Committee Report: Microbiological Considerations for Drinking Water Regulation Revisions,
W87-08959 5F

Handbook of Public Water Systems.
W87-09063 5F

Handbook of Chlorination,
W87-09064 5D

Safe Drinking Water: The Impact of Chemicals on a Limited Resource.
W87-09114 5C

Public Drinking Water and Chemicals,
W87-09117 5C

Bottled Water: An Alternative Source of Safe Drinking Water,
W87-09118 5F

Overview of Point-of-Use Water Treatment Technology,
W87-09119 5F

Effective Alternative to Official Regulation of Indirect Additives to Drinking Water,
W87-09120 5F

Water Treatment Chemicals Codex,
W87-09121 5F

Disinfectant Chemistry In Drinking Water - Overview of Impacts on Drinking Water Quality,
W87-09122 5F

By-Products of Chlorination: Specific Compounds and Their Relationship to Total Organic Halogen,
W87-09123 5F

Ozone for Drinking Water Treatment - Evolution and Present Status,
W87-09124 5F

Handbook of Ozone Technology and Applications Volume II: Ozone for Drinking Water Treatment.
W87-09134 5F

Removal of Iron and Manganese by Ozone during Drinking Water Treatment in Dusseldorf,
W87-09136 5F

Control of Tastes and Odors in Drinking Water with Ozone,
W87-09137 5F

Removal of Color from Drinking Water with Ozone,
W87-09138 5F

Removal of Detergents from Drinking Water with Ozone,
W87-09139 5F

Removal of Pesticides from Drinking Water with Ozone,
W87-09140 5F

Removal of Ammonia and Other Nitrogen Derivatives from Drinking Water with Ozone,
W87-09141 5F

Microflocculation by Ozone,
W87-09142 5F

Closed-Loop System for Generating Ozone from Oxygen and Its Application to the Treatment of Drinking Water at Duisburg, Federal Republic of Germany,
W87-09143 5F

Biological Drinking Water Treatment Systems Involving Ozone,
W87-09144 5F

Raw Water Preozonation,
W87-09145 5F

Recent Developments in the Treatment of Drinking Water with Ozone,
W87-09146 5F

Ozone for Drinking Water Treatment: A Bibliography,
W87-09147 5F

Water Treatment: The States Zero in on Groundwater Regulation,
W87-09222 5F

Removal of Multivalent Metal Cations from Water Using Micellular-Enhanced Ultrafiltration,
W87-09223 2K

Chemical Changes of Organic Compounds in Chlorinated Water: XII. Gas Chromatographic-Mass Spectrometric Studies of the Reactions of Methylnaphthalenes with Hypochlorite in Dilute Aqueous Solution,
W87-09224 2K

Removal of Individual Off-Flavour Compounds in Water During Artificial Groundwater Recharge and During Treatment by Alum Coagulation/Sand Filtration,
W87-09267 5F

Trihalomethane Formation in Whirlpool Spas,
W87-09276 5B

Metropolitan Water Management,
W87-09338 6D

Expansion of Granular Filters During Backwashing,
W87-09371 5D

Comparison of Backwash Models for Granular Media,
W87-09372 5D

Optimal Water Treatment Plant Design,
W87-09374 5F

Sediment Diffusion in Primary Shallow Rectangular Clarifiers,
W87-09376 5F

Potassium Ferrioxalate as Chemical Actinometer in Ultraviolet Reactors,
W87-09377 5F

Survival and Multiplication of Legionella pneumophila in Municipal Drinking Water Systems,
W87-09389 5F

Scale-Up of Water and Wastewater Treatment Processes.
W87-09431 5D

Scale-Up and Scale-Down Concepts and Problems,
W87-09432 5D

Introduction to Scale-Up of Water and Wastewater Treatment Processes,
W87-09433 5D

Perspectives on the Scale-Up of Impeller Mixers,
W87-09434 5D

Important Issues in the Scale Up of New Processes,
W87-09435 5D

Factors of Scale in Rapid Sand Filtration,
W87-09440 5F

Importance of Laboratory Scale Study for the Design of Mobile-Bed Filter,
W87-09442 5F

Unique Pre-Ozonation - D.E. Filtration Water Treatment Plant Design is Based on Pilot Plant Data,
W87-09443 5F

Development of a New Type of Fluidized Bed Reactor,
W87-09444 5D

Modeling for Process Scale-Up of Adsorption and Ion Exchange Systems,
W87-09446 5D

Scale-Up of Direct Filtration (The Wahnbach System),
W87-09447 5F

Scale-Up of Biological Wastewater Treatment Processes: Practical Experiences in the U.K.,
W87-09453 5D

WATER TREATMENT FACILITIES
Cooperative Solution for a Water System 'Emergency',
W87-08807 5F

Handbook of Public Water Systems.
W87-09063 5F

WATER USE
Proposals for Agricultural Development of Wadi Dhuleil Catchment, Jordan,
W87-08739 3F

Study of Saline Water Use at the Harry Allen Generating Station,
W87-09332 3C

WATER VAPOR
Water Vapor Transport Over the Indian Ocean During the 1979 Summer Monsoon. Part I: Water Vapor Fluxes,
W87-08937 2B

WATER VAPOR UPTAKE
Water Vapor Uptake and Photosynthesis of Lichens: Performance Differences in Species with Green and Blue-Green Algae as Phycobionts,
W87-09345 2I

WATER YIELD
Estimation of Groundwater Recharge in Sandy Till with Two Different Methods Using Groundwater Level Fluctuations,
W87-08615 2F

WATERDROP IMPACT
Relationships Between Waterdrop Properties and Forces of Impact,
W87-09004 2J

WATERFLEAS
Comparative Metabolism of Fenitrothion in Aquatic Organisms: III. Metabolism in the Crustaceans, Daphnia pulex and Palaemon paucidens,
W87-08861 5B

WATERFOWL
Effects of the Ixtoc I Oil Spill on Texas Shorebird Populations,
W87-09555 5C

WATERLOGGING
Hydrology and Drainage of Peatland,
W87-09201 2G

Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XI. Growth of Geum rivale L. and Geum urbanum L. and Soil Chemical Condition in Experimentally Flooded Soil,
W87-09398 2I

Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XII. Growth, Photosynthetic Capacity and Metal Ion Uptake in Salix caprea and S. Cinerea ssp. Oleifolia,
W87-09399 2I

Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XIII. The Effect of Fe(2+) on Photosynthesis and Respiration of Salix caprea and S. cinerea ssp. oleifolia,
W87-09400 2I

Effect of Waterlogging on Infection of Eucalyptus marginata Seedlings by Phytophthora cinnamomi,
W87-09401 2I

WATERSHEDS
Shifting of the Kosi River, Northern India,
W87-08834 2E

Transport of Solids in Streamflow from Coastal Plain Watersheds,
W87-08924 2J

Riparian Areas as Filters for Agricultural Sediment,
W87-09002 4A

WATERWAYS
Engineering Measures: Waterways and Diversion Channels,
W87-08666 8A

WAVE ACTION
Simplified Models to Predict the Breakup of Oil on Rough Seas,
W87-09521 5B

WAVES
Conformal-Mapping Technique for Topographic-Wave Problems: Semi-Infinite Channels and Elongated Basins,
W87-09384 7C

Erosion Control of Scour During Construction; Report 6: FINITE - A Numerical Model for Combined Refraction and Diffraction of Waves,
W87-09482 8B

WEATHER FORECASTING
Experimental Monthly Long Lange Forecasts for the United Kingdom: Part III. Skill of the Monthly Forecasts.
W87-08701 2B

Snow Forecasts from the Meteorlogical Office Fine-mesh Model During the Winter of 1985/86,
W87-08702 2B

Empirical Prediction of the Summer Monsoon Rainfall over India,
W87-08940 2B

Canadian Atlantic Storms Program: The Meteorological Field Project,
W87-09255 2B

Climate Forecast Verifications, U.S. Mainland, 1974-82,
W87-09499 2B

WEATHER MODIFICATION
SCPP Meteorological and Statistical Support for Period 1 September 1985, 31 August 1986, Volume I: Interim Progress Report,
W87-09334 2B

WEBER BASIN
Prehistoric Cultural Resources Study Predictive Model and Field Survey Weber Basin Project,
W87-09335 6G

WEED CONTROL
Comparative Study on the Intrinsic Rates of Increase of Cyrtobagous singularis and C. salviniae on the Water Weed Salvinia molesta,
W87-09217 4A

Evaluation of the Model CE-QUAL-R1 for Use by the Aquatic Plant Control Research Program,
W87-09486 5B

WEIR BOOM
Development and Testing of a Weir Boom for Oil Recovery at Sea,
W87-09563 5G

WEIRS
Lateral Outflow over Side Weirs,
W87-09196 8A

WELL DRILLING
Monitoring Well Installation, Purging, and Sampling Techniques - Part 1: Conceptualizations,
W87-08755 7B

WELL LOGS
Application of Isotope Techniques and Well Loggind in Investigating Ground Water Influenced by Mining,
W87-09580 2F

WELLS
Unsteady Flow to Wells in Layered and Fissured Aquifer Systems,
W87-08618 2F

Reverse Pathline Calculation of Time-Related Capture Zones in Nonuniform Flow,
W87-08753 2F

WEST GERMANY
Closed-Loop System for Generating Ozone from Oxygen and Its Application to the Treatment of Drinking Water at Duisburg, Federal Republic of Germany,
W87-09143 5F

Recent Developments in the Treatment of Drinking Water with Ozone,
W87-09146 5F

WEST VIRGINIA
New Approach for Regulating Iron in Water Quality Standards,
W87-08636 5G

WESTFIELD RIVER
Effects of an Acidic River, Caused by Acidic Rain, on Weight Gain, Steroidogenesis, and Reproduction in the Atlantic Salmon (Salmo salar),
W87-08651 5C

WET DEPOSITION
Modeling of Atmospheric Wet Deposition,
W87-09165 5B

WETLAND CONSERVATION
Plants and Peat Cuttings: Historical Ecology of a Much Exploited Peat land-Thorne Waste. Yorkshire, UK,
W87-09342 4C

WETLANDS
Production-Destruction Processes in Ecosystems of Grassy Marshes of the Amur River Region,
W87-08709 2H

Growth and Survival of Giant Ragweed (Ambrosia trifida L.) in a Delaware River Freshwater Tidal Wetland,
W87-08714 2H

Establishing Smooth Cordgrass in Tidal Wetlands,
W87-08806 2I

Hydrology, Water Chemistry and Ecological Relations in the Raised Mound of Cowles Bog,
W87-08837 2H

Geochemistry of Humic Substances in Natural and Cultivated Peatlands,
W87-09069 2H

Wetlands Policy Crisis: United States and United Kingdom,
W87-09215 6E

Changes at Panicle Emergence in the Water Relations of a Wetland and a Dryland Japonica Rice Cultivar Under Wetland Conditions,
W87-09415 2I

Examination of Tidal Flats, Vol. 1: Research Report.
W87-09492 4C

WHEAT
Water Production Functions for Wheat under Different Environmental Conditions,
W87-08748 3F

Spring Wheat Growth at High and Low Soil Water with Constricted Upper Roots,
W87-08893 2D

Synthesis of a Simplified Water Use Simulation Model for Predicting Wheat Yields,
W87-09028 2I

WHEAT

Leaf Photosynthesis and Conductance of Selected Triticum Species at Different Water Potentials,
W87-09419 2I

WHIRLPOOL SPAS
Trihalomethane Formation in Whirlpool Spas,
W87-09276 5B

WHITEFISH
Whitefish and Vendace Stocks in the Regulated Lake Pyhajarvi, Central Finland,
W87-09052 2H

Food of Whitefish (Coregonus lavaretus) in Two Neighbouring Lakes, One Regulated and the Other Natural,
W87-09055 2H

WHITING
Effect of 'Whiting' on Optical Properties and Turbidity in Owasco Lake, New York,
W87-08966 2H

WILDLIFE
Valuing Wildlife in Benefit-Cost Analyses: A Case Study Involving Endangered Species,
W87-09032 6B

Manual of Stream Channelization Impacts on Fish and Wildlife,
W87-09497 6G

WILDLIFE HABITAT
Examination of Tidal Flats, Vol. 3: Evaluation Methodology.
W87-09493 4C

WIND EFFECTS
Resuspension in the Shallow Sublittoral Zone of a Macrotidal Estuarine Environment: Wind Influence,
W87-08933 2L

WIND VELOCITY
Correction of Liquid Precipitation,
W87-08813 2B

WINDS
Water Vapor Transport Over the Indian Ocean During the 1979 Summer Monsoon. Part I: Water Vapor Fluxes,
W87-08937 2B

Relationship of Low-Level Winds and Moisture to Convection in the Tropical Pacific,
W87-08941 2B

WORLD HEALTH ORGANIZATION
World Health Organization and Guidelines and European Economic Community Directives,
W87-09130 6E

WYOMING
Small-Scale Hydroelectric Power.
W87-09110 6A

Water-Quality Monitoring at the Hoe Creek Test Site: Review and Preliminary Conclusions,
W87-09495 5B

Unique Inland Oil Spill - Glenrock, Wyoming,
W87-09532 5G

X-RAY SPECTROGRAPHS
Method to Estimate Soil Loss From Erosion,
W87-09007 7B

XYLENES
Effectiveness of Offshore Produced Water Treatment,
W87-09515 5D

YAKIMA RIVER
Prehistoric Hunter-Gatherers of South Central Arizona: The Picacho Reservoir Archaic Project,
W87-09491 6G

YELLOW SUBSTANCE
Absorption of Light by Yellow Substance in Freshwater Lakes,
W87-08934 2H

ZIMBABWE
Biological Denitrification of a Highly Nitrogenous Industrial Effluent: A Case Study in Zimbabwe,
W87-08964 5D

ZINC
Seasonal Variation of Copper and Zinc Concentrations in the Oyster Saccostrea cucullata from the Dampier Archipelago, Western Australia: Implications for Pollution Monitoring,
W87-08732 5B

Heavy Metals in Lake Kinneret (Israel): II. Hydrogen Sulfide Dependent Precipitation of Copper, Cadmium, Lead and Zinc,
W87-08761 2H

Statistical Assessment of a Sampling Pattern for Evaluation of Changes in Mercury and Zinc Concentrations in Patella coerulea,
W87-08884 5A

Effects of pH and Soil Type on Concentrations of Zinc, Copper and Nickel Extracted by Calcium Chloride from Sewage Sludge-Treated Soils,
W87-08911 5B

Atmospheric Lead and Zinc Deposition into Lakes of the Eastern United States,
W87-09183 5B

ZINC ISOTOPES
Investigation into the Retention of 65Zn Absorbed by the Trophic Pathway in Cyprinus Carpio L. Influence of the Ingestion Frequency and the Radiozinc Content of Food (Etude de la Retention Du 65Zn Absorbe par voie Trophique Chez Cyprinus Carpio L. Influence du Rythme D'Ingestion et de la Teneur en Radiozinc de la Nourriture),
W87-09268 5B

ZOOPLANKTON
Effects of Food Availability and Fish Predation on a Zooplankton Community,
W87-08799 2H

Trophic Interactions in the Plankton of Malyi Sevan in July, 1984,
W87-09219 2H

Power-Plant-Related Estuarine Zooplankton Studies,
W87-09316 5C

AUTHOR INDEX

AARSTAD, J. S.
Control of Furrow Erosion With Crop Residues and Surge Flow Irrigation,
W87-09003 3F

AASE, J. K.
Soil Water Evaporation Comparisons Among Tillage Practices in the Northern Great Plains,
W87-09006 2D

ABBISS, T. P.
Fate and Effects of Dispersant-Treated Compared with Untreated Crude Oil, with Particular Reference to Sheltered Intertidal Sediments,
W87-09537 5G

ABDEL-GHAFFAR, A. M.
2-D Elastoplastic Seismic Shear Response of Earth Dams: Applications,
W87-08608 8A

2-D Elastoplastic Seismic Shear Response of Earth Dams: Theory,
W87-08607 8A

ABERNETHY, C. S.
Effects of Suspended Volcanic Ash and Thermal Shock on Susceptibility of Juvenile Salmonids to Disease,
W87-08653 5C

ABIJOROH, D.
Public Health Significance of Industrial Pollution in Zaria, Nigeria,
W87-09226 5B

ABRAHAMS, P. W.
Spatial Variability in the Chemical Composition of Snowcover in a Small, Remote, Scottish Catchment,
W87-08945 5B

ABROL, I. P.
Effect of Exchangeable Sodium Percent on Surface Sealing,
W87-08742 4D

ABSALONSEN, N. O.
Life Cycles of Four Species of Baetis (Ephemeroptera) in Three Danish Streams,
W87-08764 2H

ABU-SHARAR, T. M.
Reduction in Hydraulic Conductivity in Relation to Clay Dispersion and Disaggregation,
W87-08996 2G

ADAMS, C. J.
Coast Guard Environmental Mission Fulfilled by Naval Salvage, French Frigate Shoals,
W87-09530 5G

ADAMS, T. M.
Effects of pH and Soil Type on Concentrations of Zinc, Copper and Nickel Extracted by Calcium Chloride from Sewage Sludge-Treated Soils,
W87-08911 5B

Zinc, Copper and Nickel Concentrations in Soil Extracts and Crops Grown on Four Soils Treated with Metal-loaded Sewage Sludges,
W87-09244 5B

ADAMS, V. D.
Potassium Ferrioxalate as Chemical Actinometer in Ultraviolet Reactors,
W87-09377 5F

ADEOYE, K. B.
Physical Changes Induced by Rainfall in the Surface Layer of an Alfisol, Northern Nigeria,
W87-09214 2G

ADVALKAR, P. C.
Role of Hydrogeology in Coal Mining Near Chandrapur in Maharashtra, India,
W87-09569 2F

AFIF, M.
Geotechnical Aspects of Corani Reservoir Enlargement,
W87-08794 8A

AGGARWAL, P. K.
Irrigation in India: A Physiological and Phenological Approach to Water Management in Grain Crops,
W87-09468 3F

AGOGINO, G.
Report on Additional Human Skeletal Material Exposed by Reservoir Induced Erosion at Lake Altus, Southwestern Oklahoma,
W87-09161 6G

AGRON, N. A.
Proposed Hydrogeological Model for Future Lignite Mining and Groundwater Drainage in the Hula Basin, Northern Israel,
W87-09578 2F

AHLGREN, I.
Thymidine Incorporation and Microbial Respiration in the Surface Sediment of a Hypereutrophic Lake,
W87-08936 2H

AHMAD, S.
Changes at Panicle Emergence in the Water Relations of a Wetland and a Dryland Japonica Rice Cultivar Under Wetland Conditions,
W87-09415 2I

AHMED, A.
New Method for Lining of Field Irrigation Channels,
W87-08750 3F

AIBA, S.
Ecohydrodynamics and Simulation: Some Relevant Problems of Scale-Up and -Down,
W87-09436 5C

AIKEN, G. R.
Isolation and Concentration Techniques for Aquatic Humic Substances,
W87-09080 2H

Molecular Size and Weight Measurements of Humic Substances,
W87-09085 7B

AIXING, T.
Future Trends in Hydropower Development in China,
W87-09407 8A

AL-OBAIDY, S.
Organochlorine Pesticide Residues in Fish from the Shatt al-Arab River, Iraq,
W87-08880 5B

AL-OGAILY, N.
Organochlorine Pesticide Residues in Fish from the Shatt al-Arab River, Iraq,
W87-08880 5B

AL-OMAR, M.
Organochlorine Pesticide Residues in Fish from the Shatt al-Arab River, Iraq,
W87-08880 5B

AL-REKABI, H. N.
Residues of Organochlorine Pesticides in Environmental Samples from the Shatt-al-Arab River, Iraq,
W87-08910 5B

AL-SAAD, H. T.
Residues of Organochlorine Pesticides in Environmental Samples from the Shatt-al-Arab River, Iraq,
W87-08910 5B

ALAMIS, M. L.
Anaerobic Treatment of Distillery Slops Using an Upflow Anaerobic Filter Reactor,
W87-08890 5D

ALDRIDGE, D. W.
Effects of Intermittent Exposure to Suspended Solids and Turbulence on Three Species of Freshwater Mussels,
W87-09381 6G

ALEXANDER, H. C.
What Industry is Doing to Protect Aquatic Life,
W87-08628 5G

ALEXANDER, M. M.
Impact of Oil on Marsh Communities in the St. Lawrence River,
W87-09541 5C

ALEXANDER, R. B.
Water-Quality Trends in the Nation's Rivers,
W87-08779 5G

ALIKHAN, M. A.
Zinc, Iron, Manganese, and Magnesium Accumulation in Crayfish Populations Near Copper - Nickel Smelters at Sudbury, Ontario, Canada,
W87-09243 5C

ALKEZWEENY, A. J.
Tracer Study of Vertical Exchange by Cumulus Clouds,
W87-08699 2A

ALLAIN, P.
Gas Chromatographic Analysis of Volatile Compounds in Water and Biological Samples with an Automatic Injector,
W87-09012 7B

ALLAM, M. N.
Allocation Model for Irrigation Water Cost: Case Study of the Nile Valley in Egypt,
W87-08968 6C

ALLEN, E. B.
Water Relations of Xeric Grasses in the Field: Interactions of Mycorrhizzas and Competition,
W87-09341 2I

ALLEN, M. F.
Water Relations of Xeric Grasses in the Field: Interactions of Mycorrhizzas and Competition,
W87-09341 2I

ALLERUP, P.
Correction of Liquid Precipitation,
W87-08813 2B

ALOUINI, Z.
Kinetics and Mechanisms of Hypochlorite Oxidation of alpha-Amino Acids at the Time of Water Disinfection (Cinetiques et Mechanismes de l'Action Oxydative de l'Hypochlorite sur les Acides alpha-Amines lors de la Desinfection des Eaux),
W87-09274 5F

ALVAREZ, R.
NBS Environmental Standard Reference Materials for Use in Validating Water Analysis,
W87-09127 5A

ALY, O. M.
Chemistry of Natural Waters,
W87-09149 2K

AMAYENC, P.
Tropical Squall Line Observed During the COPT 81 Experiment in West Africa. Part I: Kinematic Structure Inferred from Dual-Doppler Radar Data,
W87-08939 2B

AMER, F.
Estimating Water Table Contribution to the Water Supply of Maize,
W87-08740 3F

ANDERSEN, J. H.
New Procedures for Flood Estimation in Norway,
W87-08811 2E

ANDERSON, A.-C.
Influence of Underground Constructions in Crystalline Rock on Groundwater Conditions and the Use of Artificial Recharge to Restore a Lowered Piezometric Surface,
W87-09589 4B

ANDERSON, G. D.
Nonpoint Agricultural Pollution: Pesticide Contamination of Groundwater Supplies,
W87-09213 5B

ANDERSON, G. K.
Applications of Porous Membranes for Biomass Retention in Biological Wastewater Treatment Processes,
W87-08889 5D

ANDERSON, J. W.
Response of Marine Animals to Petroleum and Specific Petroleum Hydrocarbons,
W87-09308 5C

Toxicity of Chemically Dispersed Oil to Shrimp Exposed to Constant and Decreasing Concentrations in a Flowing System,
W87-09516 5C

ANDERSON, M. P.
Introduction to Groundwater Modeling: Finite Difference and Finite Element Methods,
W87-08684 2F

ANDERSON, M. R.
Regulation of Submerged Aquatic Plant Distribution in a Uniform Area of a Weedbed,
W87-08836 2H

ANDERSON, R. J.
Epidemiology of Dental Caries in Relation to Environmental Trace Elements,
W87-08694 5C

ANDERSSON, T.
Long-Term Effects of Bleached Kraft Mill Effluents on Carbohydrate Metabolism and Hepatic Xenobiotic Biotransformation Enzymes in Fish,
W87-08854 5C

ANDREASSON, P.
River Flow with Excessive Suspended Sediment Load: An Evaluation of Turbulent Flow Characteristics,
W87-08826 2E

ANDREN, A. W.
Atmospheric Deposition of Particulate Organic Carbon and Polyaromatic Hydrocarbons to Lake Michigan,
W87-09187 5B

ANDREWS, S. A.
Toxicity of Ballast-Water Treatment Effluent to Marine Organisms at Port Valdez, Alaska,
W87-09514 5C

ANGLE, J. S.
Residual Effects of Sewage Sludge on Soybean: I. Accumulation of Heavy Metals,
W87-08921 5C

Residual Effects of Sewage Sludge on Soybean: II. Accumulation of Soil and Symbiotically Fixed Nitrogen,
W87-08922 5C

ANGLO, P. G.
Anaerobic Treatment of Distillery Slops Using an Upflow Anaerobic Filter Reactor,
W87-08890 5D

ANLIKER, R.
Limits of Bioaccumulation of Organic Pigments in Fish: Their Relation to the Partition Coefficient and the Solubility in Water and Octanol,
W87-08853 5B

ANNACHHATRE, A. P.
Methane Recovery from Water Hyacinth Through Whole-Cell Immobilization Technology,
W87-09420 5D

APOSTOLOPOULOU, A.
Correlation of Some Organic Pollution Factors in Water Systems in Northern Greece,
W87-09264 5B

APPERSON, C. S.
Prediction of the Occurrence of Four Species of Mosquito Larvae with Logistic Regression on Water-Chemistry Variables,
W87-08846 2H

APPLEGATH, S. L.
Brood Size and Neonate Weight of Daphnia magna Produced by Nine Diets,
W87-08641 2H

Sensitivity of Chronic Endpoints Used in Daphnia Magna Straus Life-Cycle Tests,
W87-08642 5C

ARAIN, R.
Nature of Organic Matter in Rivers with Deep Sea Connections: The Ganges-Brahmaputra and Indus,
W87-08721 2H

ARANHA, H. G.
Effect of Crude Oil on Microbial Processes in Marine Sediments,
W87-09567 5C

ARAVAMUDAN, K. S.
Simplified Models to Predict the Breakup of Oil on Rough Seas,
W87-09521 5B

ARDAHL, A. H.
Effect of Crude Oil on Microbial Processes in Marine Sediments,
W87-09567 5C

ARMSTRONG, G. S.
Ameliorative Methods to Reinstate Fisheries Following Land Drainage Operations,
W87-09048 6G

ARNOLD, D. E.
Vulnerability of Selected Lakes and Streams in the Middle Atlantic Region to Acidification: A Regional Survey,
W87-09476 5B

ARNOLD, J. R.
In Situ Cosmogenic 3H, 14C, and 10Be for Determining the Net Accumulation and Ablation Rates of Ice Sheets,
W87-09249 2C

ARNOLD, T. E.
New Approach for Regulating Iron in Water Quality Standards,
W87-08636 5G

ARNY, C. J.
Impact of Simulated Acidic Precipitation on Quantity and Quality of a Field Grown Potato Crop,
W87-08789 5C

ARON, G.
Rainfall Abstractions,
W87-09099 2A

ARORA, V. K.
Synthesis of a Simplified Water Use Simulation Model for Predicting Wheat Yields,
W87-09028 2I

ARSHENEVSKII, N. N.
Programmed Closing of Gates Upon Loss of Drive by a Pump Unit,
W87-09355 8C

ARTHUR, J.
Biological Effects of Continuous and Intermittent Dosing of Outdoor Experimental Streams with Chloropyrifos,
W87-08634 5C

ARVOLA, L.
Three Day Study of the Diel Behaviour of Plankton in a Highly Humic and Steeply Stratified Lake,
W87-08766 2H

ASAI, S.
Separation of Mercury from Aqueous Mercuric Chloride Solutions by Onion Skins,
W87-08606 5D

ASHENDEN, T. W.
Yield Reductions in Winter Barley Grown on a Range of Soils and Exposed to Simulated Acid Rain,
W87-09416 5C

ASHKAR, F.
Generalized Method of Moments as Applied to Problems of Flood Frequency Analysis: Some Practical Results for the Log-Pearson Type 3 Distribution,
W87-08616 2E

AUCLAIR, A. N. D.
Mathematical Model of Seasonal and Spatial Variation in Phosphorus Concentrations in Lake Memphremagog, Quebec,
W87-08899 5B

AUNE, T.
Freshly Prepared Rat Hepatocytes Used in Screening the Toxicity of Blue-Green Algal Blooms,
W87-09230 5A

AUSTIN, G. L.
Relative Accuracy of Satellite and Raingage Rainfall Measurements over Middle Latitudes during Daylight Hours,
W87-08700 2B

AVAKYAN, A. B.
Evaluations of the Recreational Potential of Reservoirs in Design Practice,
W87-09360 2H

AVERILL, D. W.
Scale-Up of a Radium-226 Removal Process,
W87-09448 5D

AVIRAM, C.
Irrigation with Brackish Water under Desert Conditions: IV. Salt Tolerance Studies with Lettuce (Lactuca sativa L.),
W87-08746 3C

AYARS, J. E.
Artificial Ground Water Recharge by Flooding During Grapevine Dormancy,
W87-08979 2F

AZCUE, J. M.
Heavy Metal Pollution in the Paraiba do Sul River, Brazil,
W87-08718 5B

AZEEZ, P. A.
Influence of Light on Chlorophyll, a Content of Blue-Green Algae Treated with Heavy Metals,
W87-09242 5C

BABCOCK, W. A.
Yakima River Basin Historical Resource Survey, Volume I: Overview and Management Recommendations,
W87-09192 6G

BABICH, H.
In Vitro Cytotoxicity of Organic Pollutants to Bluegill Sunfish (BF-2) Cells,
W87-08843 5C

BACALBASA-DOBROVICI, N.
Effects on Fisheries of Non-Biotic Modifications of the Environment in the East-Danube River Area,
W87-09038 6G

BACKHAUS, F.
Environmental Specimen Bank Specific Reference Materials - Main Aims and Preparation,
W87-08918 5A

BACKIEL, T.
Fall of Migratory Fish Populations and Changes in Commercial Fisheries in Impounded Rivers in Poland,
W87-09039 6G

BAECKSTROEM, L.
Influence on the Groundwater Conditions in a Multilayered Aquifer System by Alum-Shale Mining,
W87-09570 5C

BAER, K. N.
Influence of Cadmium Exposure on Selected Hematological Parameters in Freshwater Teleost, Notemigonus crysoleucas,
W87-08857 5C

BAGATTO, G.
Zinc, Iron, Manganese, and Magnesium Accumulation in Crayfish Populations Near Copper - Nickel Smelters at Sudbury, Ontario, Canada,
W87-09243 5C

BAGDY, I.
Plans and Experiments to Deal with Large Amounts of Sediment in Hungarian Mines under Karstic Water Hazard,
W87-09590 4C

BAH, A.
Resuspension in the Shallow Sublittoral Zone of a Macrotidal Estuarine Environment: Wind Influence,
W87-08933 2L

BAIER, R. E.
Sampling and Composition of the Surface Microlayer,
W87-09173 5A

BAILEY, H. C.
Comparative Toxicity of SRC-I Wastewater to Aquatic Organisms,
W87-09106 5C

Time/Toxicity Relationships in Short-Term Static, Dynamic, and Plug-Flow Bioassays,
W87-08639 5C

BAILEY, R. E.
Comparison of Parasite Fauna of Juvenile Sockeye Salmon (Oncorhynchus Nerka) from Southern British Columbian and Washington State Lakes,
W87-08792 2H

BAKER, E. T.
Suspended Particulate Matter in Commencement Bay,
W87-09498 2J

BAKER, J. M.
Fate and Effects of Dispersant-Treated Compared with Untreated Crude Oil, with Particular Reference to Sheltered Intertidal Sediments,
W87-09537 5G

BAKER, K. K.
Systematics and Ecology of Lyngbya spp. and Associated Species (Cyanophyta) in a New England Salt Marsh,
W87-09423 2L

BAKER, T. H. W.
Measurement of Soil Water Content Using the Combined Time-Domain Reflectometry - Thermal Conductivity Probe,
W87-08796 2G

BALCERZAK, A.
Application of New Chemical Grouts in Strengthening and Sealing of Soils,
W87-09594 8G

BALDI, F.
Mercury Pollution in Marine Sediment Cores Near Cinnabar Deposits and a Chlor-Alkali Plant,
W87-08727 5B

BALLOU, T.
Mapping the Distribution of Protected and Valuable, Oil-Sensitive Coastal Fish and Wildlife,
W87-09540 7A

BALLS, P. W.
Composition of Suspended Particulate Matter from Scottish Coastal Waters Geochemical Implications for the Transport of Trace Metal Contaminants,
W87-08729 5B

BALMER, P.
Removal of Individual Off-Flavour Compounds in Water During Artificial Groundwater Recharge and During Treatment by Alum Coagulation/Sand Filtration,
W87-09267 5F

BALOGUN, J. K.
Distribution and Relative Abundance of the Nile Perch (Lates niloticus (L.) Pisces: Centropomidae) in Lake Kainji, Nigeria,
W87-08762 2H

BANDYOPADHYAY, B. K.
Volatilization Loss of Nitrogen from Submerged Saline Soil,
W87-08892 2G

BANERJEE, D. K.
Influence of Light on Chlorophyll, a Content of Blue-Green Algae Treated with Heavy Metals,
W87-09242 5C

BANERJEE, S. P.
Mine Drainage Problems in Indian Coalfields, with Special Reference to the Problems in Jharia Coalfield,
W87-09571 4C

BARBARICK, K. A.
Ammonium Bicarbonate-DTPA and DTPA Extractions of Sludge-Amended Soils,
W87-08923 5A

BARLOCHER, F.
Digestion of Carbohydrates and Protein by Gammarus mucronatus Say (Amphipoda),
W87-08839 2L

BARTHOLOMEW, C. L.
Embankment Dam Instrumentation Manual,
W87-09157 8A

BATES, D. J.
Field Survey of Heavy Metal Uptake by Naturally Occurring Saltwater and Freshwater Marsh Plants,
W87-09490 5B

BATES, J. M.
Assessment of Effluent Impacts through Evaluation of Periphyton Diatom Community Structure,
W87-09320 5C

BATHKE, G. R.
Semiportable Multislot Divisor for Erosion and Runoff Measurements,
W87-09010 7B

BAUDER, J. W.
Vacuum Trough Extractors for Measuring Drainage and Nitrate Flux Through Sandy Soils,
W87-08989 7B

BAUDIN, J. P.
Investigation into the Retention of 65Zn Absorbed by the Trophic Pathway in Cyprinus Carpio L. Influence of the Ingestion Frequency and the Radiozinc Content of Food (Etude de la Retention Du 65Zn Absorbe par voie Trophique Chez Cyprinus Carpio L. Influence du Rythme D'Ingestion et de la Teneur en Radiozinc de la Nourriture),
W87-09268 5B

BAUER, C. F.
Accuracy of Selective Extraction Procedures for Metal Speciation in Model Aquatic Sediments,
W87-08985 5A

BAUGHMAN, G. L.
Fate Modeling,
W87-09298 5B

BAUMANN, E. R.
Curbing THMs in Small Water Systems,
W87-08954 5F

BAXTER-POTTER, W.
Geographic Information System to Predict Non-Point Source Pollution Potential,
W87-08977 7A

BAYHAM, F. E.
Prehistoric Hunter-Gatherers of South Central Arizona: The Picacho Reservoir Archaic Project,
W87-09191 6G

BAYLISS, R.
Wreck of the Lee Wang Zin,
W87-09528 5G

BEACH, R. L.
Development of a Flaring Burner Oil Disposal System,
W87-09560 5D

BEAN, R. M.
Toxicity of Chemically Dispersed Oil to Shrimp Exposed to Constant and Decreasing Concentrations in a Flowing System,
W87-09516 5C

BEAUCHEMIN, D.
Determination of Trace Metals in a River Water Reference Material by Inductively Coupled Plasma Mass Spectrometry,
W87-08832 5A

BEAUHEIM, R. L.
Basic Data Report for Drilling and Hydrologic Testing of Drillhole DOE-2 at the Waste Isolation Pilot Plant (WIPP) Site,
W87-09333 5E

BEAVERS, A. H.
Method to Estimate Soil Loss From Erosion,
W87-09007 7B

BECKER, E.
Cooperative Solution for a Water System 'Emergency',
W87-08807 5F

BEHEL, D.
Attenuation of Cd and Pb Solubility in Municipal Waste Incinerator Ash,
W87-08776 5E

BELANGER, G.
Salinity During Embryonic Development Influences the Response to Salinity of Gasterosteus Aculeatus L. (Trachurus),
W87-08793 2H

BELEN, M. S.
Spreading, Dispersion, and Evaporation of Oil Slicks in the Arabian Gulf,
W87-09522 5B

BELL, F. G.
Groundwater Resource Development,
W87-09148 6D

BELL, R. T.
Thymidine Incorporation and Microbial Respiration in the Surface Sediment of a Hypereutrophic Lake,
W87-08936 2H

BELL, S.
Yield Reductions in Winter Barley Grown on a Range of Soils and Exposed to Simulated Acid Rain,
W87-09416 5C

BELLON, A.
Application of Meteorological Radar Data for Simulation of Streamflow with a Hydrological

BELLON, A.

Matrix Model (Utilisation des Donnees d'un Radar Meteorologique pour la Simulation des Ecoulements en Riviere a l'aide d'un Modele Hydrologique Matriciel),
W87-08623 7B

Relative Accuracy of Satellite and Raingage Rainfall Measurements over Middle Latitudes during Daylight Hours,
W87-08700 2B

BEN-ASHER, J.
Linear Regression Model Combined with a Soil Water Balance Model to Design Micro-Catchments for Water Harvesting in Arid Zones,
W87-08738 3B

BENCALA, K. E.
Evaluation of Natural Tracers in an Acidic and Metal-Rich Stream,
W87-09021 7B

BENGTSSON, B.-E.
Long-Term Effects of Bleached Kraft Mill Effluents on Carbohydrate Metabolism and Hepatic Xenobiotic Biotransformation Enzymes in Fish,
W87-08854 5C

BENOIT, F. M.
Trihalomethane Formation in Whirlpool Spas,
W87-09276 5B

BENSON, W. H.
Influence of Cadmium Exposure on Selected Hematological Parameters in Freshwater Teleost, Notemigonus crysoleucas,
W87-08857 5C

BERCOVIER, H.
Seasonal Distribution of Legionellae Isolated from Various Types of Water in Israel,
W87-08903 5A

BERG, K.
Freshly Prepared Rat Hepatocytes Used in Screening the Toxicity of Blue-Green Algal Blooms,
W87-09230 5A

BERGMAN, G.
Influence of Underground Constructions in Crystalline Rock on Groundwater Conditions and the Use of Artificial Recharge to Restore a Lowered Piezometric Surface,
W87-09589 4B

BERGSTROM, I.
Three Day Study of the Diel Behaviour of Plankton in a Highly Humic and Steeply Stratified Lake,
W87-08766 2H

BERMAN, S. S.
Determination of Trace Metals in a River Water Reference Material by Inductively Coupled Plasma Mass Spectrometry,
W87-08832 5A

BERNHARDT, H.
Scale-Up of Direct Filtration (The Wahnbach System),
W87-09447 5F

BETTAC, M.
Efficiency and Process: Stability of Single Stage and Multi-Stage Wastewater Treatment Plants,
W87-09452 5D

BHADRA, R. K.
Evaluation of the Multitest Medium for Rapid Presumptive Identification of Vibrio cholerae from Environmental Sources,
W87-09397 5A

BHATTACHARYA, J.
Impact-Sensitiveness of Soil Oribatid Species to the Waste Water from a Coal Distillation Plant,
W87-08898 5A

BHATTACHARYA, T.
Impact-Sensitiveness of Soil Oribatid Species to the Waste Water from a Coal Distillation Plant,
W87-08898 5A

BIBLER, N. E.
Leaching Radioactive and Nonradioactive Elements from Actual Savannah River Plant Nuclear Waste Glass,
W87-09112 5B

BICHARA, A. F.
Proposals for Agricultural Development of Wadi Dhuleil Catchment, Jordan,
W87-08739 3F

BICKINGS, C. K.
Comparison of QSAR Predictions with Fish Toxicity Screening Data for 110 Phenols,
W87-08637 5C

BIDLEMAN, T. F.
Aerial Deposition of Organochlorines in Urban and Coastal South Carolina,
W87-09188 5B

BILLINGS, R. B.
Alternative Demand Model Estimators for Block Rate Pricing,
W87-08984 6C

BINGHAM, F. T.
Reduction in Hydraulic Conductivity in Relation to Clay Dispersion and Disaggregation,
W87-08996 2G

BIRCHAM, J. S.
Soil Water Balance Model for Sloping Land,
W87-08735 2A

BIRD, D. F.
Algal Phagotrophy: Regulating Factors and Importance Relative to Photosynthesis in Dinobryon (Chrysophyceae),
W87-08929 2H

BIRGE, W. J.
Research Needs for Rapid Assessments of Chronic Toxicity,
W87-08630 5C

BISHOP, R. C.
Valuing Wildlife in Benefit-Cost Analyses: A Case Study Involving Endangered Species,
W87-09032 6B

BISHOP, W. E.
Chemical Safety Evaluation,
W87-09301 5B

BLACK, J. A.
Research Needs for Rapid Assessments of Chronic Toxicity,
W87-08630 5C

BLACK, R. C.
Influence of Structure on Underground Water Prediction and Occurrence at Rokana Mine, Kitwe, Zambia,
W87-09572 2F

BLACKALL, P. J.
BIOS Project - Frontier Oil Spill Countermeasures Research,
W87-09523 5G

BLACKIE, J. R.
Effect of Upland Pasture Improvement on Nutrient Release in Flows from a 'Natural' Lysimeter and a Field Drain,
W87-08741 5G

BLACKWOOD, I.
Spatial Variability in the Chemical Composition of Snowcover in a Small, Remote, Scottish Catchment,
W87-08945 5B

BLACKWOOD, I. L.
Effect of Polluted and Leached Snow Melt Waters on the Soil Bacterial Community--Quantitative Response,
W87-08874 5C

BLAKE, G.
Ecological Modelling of a High Mountain Reservoir in Relation to Particulate Organic Matter Loading,
W87-08786 2H

BLANCHARD, C.
American West's Acid Rain Test,
W87-09160 5B

BLASER, O.
Quantification of PCB by Dechlorination to Biphenyl,
W87-09259 5A

BLAU, G. E.
Environmental Systems Analysis: An Overview,
W87-08671 5B

BLOMBERG, E.
Experiences Gained From Deployment of Booms and Skimmers in Various Oil Recovery Applications,
W87-09564 5G

BLOOMFIELD, P.
Prediction of the Occurrence of Four Species of Mosquito Larvae with Logistic Regression on Water-Chemistry Variables,
W87-08846 2H

BLUESTONE, M.
Water Treatment: The States Zero in on Groundwater Regulation,
W87-09222 5F

BNINSKA, M.
Effect of Recreational Uses Upon Aquatic Ecosystems and Fish Resources,
W87-09060 6G

BOATENG, K.
Monitoring Well Installation, Purging, and Sampling Techniques - Part 1: Conceptualizations,
W87-08755 7B

BOBEE, B.
Generalized Method of Moments as Applied to Problems of Flood Frequency Analysis: Some Practical Results for the Log-Pearson Type 3 Distribution,
W87-08616 2E

BOCKSTAEL, N. E.
Estimating the Value of Water Quality Improvements in a Recreational Demand Framework,
W87-09033 6C

BOERS, T. M.
Linear Regression Model Combined with a Soil Water Balance Model to Design Micro-Catchments for Water Harvesting in Arid Zones,
W87-08738 3B

BOGARDUS, R. B.
Ecological Factors in the Selection of Representative Species for Thermal Effluent Demonstrations,
W87-09315 5C

BOHNERT, H. J.
Induction of Crassulacean Acid Metabolism in Mesembryanthemum crystallinum by High Salinity: Mass Increase and de Novo Synthesis of PEP-Carboxylase,
W87-09418 3C

BOHNKE, B.
Development of a Competitive Two-Stage Biological Treatment System: Results of Pilot Plants and Full Scale Plants,
W87-09454 5D

Efficiency and Process: Stability of Single Stage and Multi-Stage Wastewater Treatment Plants,
W87-09452 5D

BOICHENKO, V. K.
Evaluations of the Recreational Potential of Reservoirs in Design Practice,
W87-09360 2H

BOLDUR, I.
Exposure to Legionella in Geriatric Institutions,
W87-08907 5B

BOLLINGER, M. S.
Sedimentation and Bioturbation in a Salt Marsh as Revealed by 210Pb, 137Cs, and 7Be Studies,
W87-08932 2L

BONDE, T. J. H.
Limnological Investigations: Lake Koocanusa, Montana; Part 3: Basic Data, Post-Impoundment, 1972-1978,
W87-09463 2H

BOON, A. G.
Scale-Up of Biological Wastewater Treatment Processes: Practical Experiences in the U.K.,
W87-09453 5D

BOOTY, W. G.
Acid Neutralizing Capacity of Fine Soil Fractions,
W87-09180 2G

BORAN, D. A.
Geochemistry of Humic Substances in Seawater,
W87-09075 2L

BORDNER, R. H.
Comparison of the Hydrophobic-Grid Membrane Filter Procedure and Standard Methods for Coliform Analysis of Water,
W87-09392 5A

BOREMAN, F. H.
Decrease in Precipitation Acidity Resulting From Decreased S04(2-) Concentration,
W87-09348 5B

BOREN, H.
Removal of Individual Off-Flavour Compounds in Water During Artificial Groundwater Recharge and During Treatment by Alum Coagulation/Sand Filtration,
W87-09267 5F

Systematic Approach to Adsorption on XAD-2 Resin for the Concentration and Analysis of Trace Organics in Water Below the (mu)g/l Level,
W87-09011 5A

BORENFREUND, E.
In Vitro Cytotoxicity of Organic Pollutants to Bluegill Sunfish (BF-2) Cells,
W87-08843 5C

BORNSTEIN, N.
Epidemiological Evidence of Legionellosis Transmission through Domestic Hot Water Supply Systems and Possibilities of Control,
W87-08905 5F

BOROVIC, I.
Irrigation with Brackish Water under Desert Conditions: IV. Salt Tolerance Studies with Lettuce (Lactuca sativa L.),
W87-08746 3C

Irrigation with Brackish Water under Desert Conditions: V. Nitrogen Requirement of Tomatoes (Lycopersicon esculentum Mill.) during Germination under Drip Irrigation,
W87-08747 3C

BORST, M.
Open Ocean Skimmer Performance Tests,
W87-09562 5G

BORTHWICK, P. W.
Field Confirmation of a Laboratory-Derived Hazard Assessment of the Acute Toxicity of Fenthion to Pink Shrimp, Penaeus duorarum,
W87-08638 5C

BOTKIN, B. C.
Sediment Diffusion in Primary Shallow Rectangular Clarifiers,
W87-09376 5F

BOURGET, E.
Resuspension in the Shallow Sublittoral Zone of a Macrotidal Estuarine Environment: Wind Influence,
W87-08933 2L

BOURNE, A. S.
Comparative Study on the Intrinsic Rates of Increase of Cyrtobagous singularis and C. salviniae on the Water Weed Salvinia molesta,
W87-09217 4A

BOURQUIN, A. W.
Microbial Toxicity Studies,
W87-09287 5C

BOUTWELL, J. E.
Biological Control of Aquatic Weeds: The Efficacy of Hybrid Grass Carp in Two Southern California Irrigation Canals,
W87-09480 4A

BOWER, P. M.
Simultaneous Measurement of Primary Production by Whole-Lake and Bottle Radiocarbon Additions,
W87-08931 2H

BOYD, M. B.
Mathematical Study of the Impact on Salinity Intrusion of Deepening the Lower Mississippi River Navigation Channel,
W87-09095 5B

BOYD, S. A.
Mobility of Sludge-Borne 3,3'-Dichlorobenzidine in Soil Columns,
W87-08925 5B

BOYLE, K. J.
Valuing Wildlife in Benefit-Cost Analyses: A Case Study Involving Endangered Species,
W87-09032 6B

BOYLE, T. P.
Research Needs in Validating and Determining the Predictability of Laboratory Data to the Field,
W87-08631 5C

BOYLE, W. C.
Wastewater-Induced Soil Clogging Development,
W87-09373 5C

BRADEN, J. B.
Economic Differences Between Cumulative and Episodic Reduction of Sediment from Cropland,
W87-09090 2J

BRADFORD, J. M.
Relationships Between Waterdrop Properties and Forces of Impact,
W87-09004 2J

BRANCHFLOWER, R.
Chemical Contaminants in Bottomfish,
W87-09035 5B

BRANNON, J. M.
Development of a Simplified Column Test for Evaluation of Thickness of Capping Material Required to Isolate Contaminated Dredged Material,
W87-09091 5G

BREGER, I. A.
Geochemistry of Humin,
W87-09077 2H

BREITTMAYER, J. P.
Statistical Assessment of a Sampling Pattern for Evaluation of Changes in Mercury and Zinc Concentrations in Patella coerulea,
W87-08884 5A

BRENER, L.
Control of Tastes and Odors in Drinking Water with Ozone,
W87-09137 5F

Removal of Ammonia and Other Nitrogen Derivatives from Drinking Water with Ozone,
W87-09141 5F

Removal of Color from Drinking Water with Ozone,
W87-09138 5F

Removal of Detergents from Drinking Water with Ozone,
W87-09139 5F

Removal of Pesticides from Drinking Water with Ozone,
W87-09140 5F

BRENNAN, C. J.
Theory and Practice in the Electrometric Determination of pH in Precipitation,
W87-08949 7B

BRESLER, E.
Field Method for Estimating Hydraulic Conductivity and Matric Potential-Water Content Relations,
W87-08993 2G

BRESSAN, R. A.
Hormonal Regulation of Protein Synthesis Associated With Salt Tolerance in Plant Cells,
W87-09227 2I

BREZONIK, P. L.
Atmospheric Deposition of Acidity and Sulfur in Florida,
W87-09177 5B

Atmospheric Deposition of Nitrogen and Phosphorus in Florida,
W87-09175 5B

Importance of Atmospheric Fluxes to the Nitrogen Balance of Lakes in the Florida Peninsula,
W87-09176 2H

BRIAND, F.
Bacteria as Structuring Agents in Lakes: Field Manipulations with Bacterioplankton,
W87-08768 2H

BRIMBLECOMBE, P.
Spatial Variability in the Chemical Composition of Snowcover in a Small, Remote, Scottish Catchment,
W87-08945 5B

BROADAWAY, S. C.
Operational Variables and the Release of Colonized Granular Activated Carbon Particles in Drinking Water,
W87-08957 5F

BRODERSEN, C. C.
Toxicity of Ballast-Water Treatment Effluent to Marine Organisms at Port Valdez, Alaska,
W87-09514 5C

BROMAN, D.
Characterization of the PAC Profile in Settling Particulates from the Urban Waters of Stockholm,
W87-09237 5B

BROOKS, S. D.
Brood Size and Neonate Weight of Daphnia magna Produced by Nine Diets,
W87-08641 2H

BROWN, I. C.
Effect of Soil Slip Erosion on Wairoa Hill Pasture Production and Composition,
W87-08734 2J

BROWNING, K. A.
Rainfall Pattern Associated with a Split Cold Front as Seen on FRONTIERS,
W87-08800 2B

BRUCE, R. R.
Irrigation Practice for Crop Culture in the Southeastern United States,
W87-09466 3F

BRUCE, T. H.
Foundation Treatment Using Pneumatically Applied Concrete,
W87-09158 8F

BRUTSAERT, W.
Capillarity Correction for Free Surface Flow of Groundwater,
W87-09018 2F

BRYAN, A. M.
Disposition of Low and High Environmental Concentrations of PCBs in Snapping Turtle Tissues,
W87-09234 5B

BRYANT, J. A.
Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XII. Growth, Photosynthetic Capacity and Metal Ion Uptake in Salix caprea and S. Cinerea ssp. Oleifolia,
W87-09399 2I

BUCHAK, E. M.
Developments in LARM2: A Longitudinal-Vertical, Time-Varying Hydrodynamic Reservoir Model,
W87-09489 8B

BUCKLEY, J.
Oil Spill Cleanup with Dispersants: A Boomed Oil Spill Experiment,
W87-09535 5G

BUFALO, G.
'Spray-Column' Laboratory Apparatus for Organic Matter Extraction from Sludges,
W87-08913 5A

BUIST, I. A.
Dome's Petroleum Study of Oil and Gas Under Sea Ice,
W87-09525 5G

BULL, R. J.
Carcinogenic Effects in A/J Mice of Particulate of a Coal Tar Paint Used in Potable Water Systems,
W87-08613 5C

BULTMAN, T. L.
Impact of Irrigation and Experimental Drought Stress on Leaf-Mining Insects of Emory Oak,
W87-09402 2I

BUNCE, J. A.
Responses of Gas Exchange to Humidity in Populations of Three Herbs from Environments Differing in Atmospheric Water,
W87-09346 2I

BURDON, D. J.
Hydrogeological Aspects of Agricultural Drainage in Ireland,
W87-09203 2E

BURGE, S. H.
Bacteriological Quality of Drinks From Vending Machines,
W87-08704 5F

BURGER, J.
Heavy Metal Concentrations in the Liver of Three Duck Species: Influence of Species and Sex,
W87-09380 5B

BURKHARDT, C. W.
Determination of Low Levels of Cationic Polyelectrolytes in Water,
W87-08986 5A

BURN, D. H.
Modeling Coliform Bacteria Subject to Chlorination,
W87-09375 5D

BURNEY, M. S.
Archaeological and Historical Surveys of Selected Portions of the Umatilla Basin Project, Umatilla County, Oregon,
W87-09425 6G

BURNS, B.
Coast Guard Environmental Mission Fulfilled by Naval Salvage, French Frigate Shoals,
W87-09530 5G

BURNS, J. C.
Swine Lagoon Effluent Applied to Coastal Bermudagrass,
W87-09472 5D

Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: I. Persistence, Yield, Quality, and Elemental Removal,
W87-08919 5C

Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: II. Rainfall Runoff and Soil Chemical Properties,
W87-08920 5C

BURNS, L. A.
Fate Modeling,
W87-09298 5B

BURQUEZ, A.
Leaf Thickness and Water Deficit in Plants: A Tool for Field Studies,
W87-08847 2D

BURSZTYNSKY, T. A.
Erosion and Sediment Control Handbook,
W87-08686 4D

BUSH, R. M.
Limnological Investigations: Lake Koocanusa, Montana; Part 3: Basic Data, Post-Impoundment, 1972-1978,
W87-09463 2H

BUTTON, V. T.
Report on Additional Human Skeletal Material Exposed by Reservoir Induced Erosion at Lake Altus, Southwestern Oklahoma,
W87-09161 6G

BUTTS, M. B.
Modelling of Unsaturated Flow in Heterogeneous Soils Part II: Stochastic Simulation of Water Flow Over a Field,
W87-08817 2G

BYERS, J. G.
Alternative Procedure for Determining the Shrinkage Limit of Soil,
W87-09159 2G

CADET, D. L.
Water Vapor Transport Over the Indian Ocean During the 1979 Summer Monsoon. Part I: Water Vapor Fluxes,
W87-08937 2B

CAILLEUX, A.
Gas Chromatographic Analysis of Volatile Compounds in Water and Biological Samples with an Automatic Injector,
W87-09012 7B

CAIRNCROSS, S.
Water Use and Health in Mueda, Mozambique,
W87-08777 5F

CAIRNS, J.
Factors Influencing Acute Toxicity of Coal Ash to Rainbow Trout (Salmo gairdneri) and Bluegill Sunfish (Lepomis macrochirus),
W87-08978 5C

CALBY, R. H.
Impact of Mesoscale Convective Systems on Regional Visibility and Oxidant Distributions during Persistent Elevated Pollution Episodes,
W87-08695 2B

CALDER, I. R.
Water Use of Eucalypts - A Review with Special Reference to South India,
W87-08749 6G

CALKINS, D. J.
Hydraulic Model Study of Port Huron Ice Control Structure,
W87-09473 2C

CAMPBELL, A. G.
Coast Guard Environmental Mission Fulfilled by Naval Salvage, French Frigate Shoals,
W87-09530 5G

CAMPBELL, G.
Simulation Model for Predicting Effect of Water Stress on Yield: An Example Using Corn,
W87-09470 3F

CAMPER, A. K.
Operational Variables and the Release of Colonized Granular Activated Carbon Particles in Drinking Water,
W87-08957 5F

CANE, A.
Effects on Salmonid Populations of Isolation of a Lake From a River System,
W87-09051 6G

CANTER, L. W.
Ground Water Pollution Control,
W87-09150 5G

Septic Tank System Effects on Ground Water Quality,
W87-09310 5C

CAPPON, C. J.
Cadmium and Lead in Lake Ontario Salmonids,
W87-08883 2H

CARDOSO, J. L.
Roman Dams in Southern Portugal,
W87-09411 6E

CARLBERG, G. E.
Systematic Approach to Adsorption on XAD-2 Resin for the Concentration and Analysis of Trace Organics in Water Below the (mu)g/l Level,
W87-09011 5A

CARLILE, D. W.
Effects of Suspended Volcanic Ash and Thermal Shock on Susceptibility of Juvenile Salmonids to Disease,
W87-08653 5C

Usefulness of the Lipid Index for Bioaccumulation Studies with Daphnia magna,
W87-08652 5C

CARLSON, A. R.
Effects of Lowered Dissolved Oxygen Concentration on the Toxicity of 1,2,4-Trichlorobenzene to Fathead Minnows,
W87-08879 5C

CARLSSON, A.
Hydrogeological Aspects of Ground Water Inflow in the Juktan Tunnels, Sweden,
W87-09591 2F

CARLSSON, L.
Influence of Underground Constructions in Crystalline Rock on Groundwater Conditions and the Use of Artificial Recharge to Restore a Lowered Piezometric Surface,
W87-09589 4B

Influence on the Groundwater Conditions in a Multilayered Aquifer System by Alum-Shale Mining,
W87-09570 5C

CARLSTEDT, A.
Influence on the Groundwater Conditions in a Multilayered Aquifer System by Alum-Shale Mining,
W87-09570 5C

CARTER, C. F.
Spatial Variability in Selected Physical Characteristics and Processes in Cross Lake, New York,
W87-08973 2H

CARTWRIGHT, K.
Hydrogeology of Underground Coal Mines in Illinois,
W87-09573 2F

CASSIDY, K. M.
Hexavalent Chromium Effects on Carbon Assimilation in Selenastrum capricornutum,
W87-08886 5C

CAVENDOR, P. N.
Seasonal Effects on Ground-Water Chemistry of the Ouachita Mountains,
W87-09428 2K

CAWLFIELD, J. D.
First-Order Reliability Approach to Stochastic Analysis of Subsurface Flow and Contaminant Transport,
W87-09017 5B

CEKIRGE, H. M.
Spreading, Dispersion, and Evaporation of Oil Slicks in the Arabian Gulf,
W87-09522 5B

CHAMBERLAIN, V.
Internal Waves of the Second Vertical Mode in a Stratified Lake,
W87-08863 2H

CHAN, W. H.
Analysis of the Impact of the Sudbury Smelters on Wet and Dry Deposition in Ontario,
W87-08942 5B

CHANDIWANA, S. K.
Knowledge Attitudes and Practices in Relation to Schistosomiasis in a Rural Community,
W87-08778 5F

CHANEY, R. L.
Residual Effects of Sewage Sludge on Soybean: I. Accumulation of Heavy Metals,
W87-08921 5C

Residual Effects of Sewage Sludge on Soybean: II. Accumulation of Soil and Symbiotically Fixed Nitrogen,
W87-08922 5C

CHANG-LIN, C.
Exploitation and Control of Karst Water in Coal Measures,
W87-09575 2F

CHANG, S.-C.
Hydrogen Sulfide Poisonings in Hot-Spring Reservoir Cleaning: Two Case Reports,
W87-08614 5C

CHAPMAN, B. R.
Effects of the Ixtoc I Oil Spill on Texas Shorebird Populations,
W87-09555 5C

CHAPMAN, G. A.
Acclimation as a Factor Influencing Metal Criteria,
W87-08635 5C

CHARPENTIER, S.
Toxicity and Bioaccumulation of Cadmium in Experimental Cultures of Duckweed, Lemna polyrrhiza L.,
W87-09241 5C

CHATTERS, J. C.
Ellisford Cremations: Internecine Hostilities in the 5th Century A.D.,
W87-09162 6G

CHEDAL, J.
Raw Water Preozonation,
W87-09145 5F

CHEKALOVSKII, E. F.
Determination of Maximum Design Discharges,
W87-09362 2E

CHENG, S. C.
Physical/Chemical Properties of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin,
W87-08657 5B

CHENG, S. T.
Overtopping Risk for an Existing Dam,
W87-09461 8A

CHEREMISINOFF, P. N.
Groundwater-Leachate: Modeling/Monitoring/Sampling,
W87-09089 5B

CHERIAN, M. P.
Fish Diversion in Hydropower Intake,
W87-09197 8I

CHERRY, D. S.
Establishment of Biotic Communities Within a Newly Constructed Ash Settling Basin and Its Drainage System,
W87-09323 5E

Factors Influencing Acute Toxicity of Coal Ash to Rainbow Trout (Salmo gairdneri) and Bluegill Sunfish (Lepomis macrochirus),
W87-08978 5C

CHIH-KUEI, C.
Exploitation and Control of Karst Water in Coal Measures,
W87-09575 2F

CHILDERS, G. W.
Effect of Crude Oil on Microbial Processes in Marine Sediments,
W87-09567 5C

CHILDRESS, S.
Scanning Currents in Stokes Flow and the Efficient Feeding of Small Organisms,
W87-09385 2H

CHIMENT, J. J.
Effect of Fertilization with Municipal Sludge on the Glutathione, Polyamine, and Cadmium Content of Cole Crops and Associated Loopers (Trichoplusia ni),
W87-08835 5C

CHING, J. K. S.
Tracer Study of Vertical Exchange by Cumulus Clouds,
W87-08699 2A

CHOMBO, F.
Knowledge Attitudes and Practices in Relation to Schistosomiasis in a Rural Community,
W87-08778 5F

CHONG, M.
Tropical Squall Line Observed During the COPT 81 Experiment in West Africa. Part I: Kinematic Structure Inferred from Dual-Doppler Radar Data,
W87-08939 2B

CHOU, C. L.
Cadmium Contamination in American Lobster, Homarus americanus, Near a Coastal Lead Smelter: Use of Multiple Linear Regression for Management,
W87-08882 5C

CHOU, L. W.
Erosion Control of Scour During Construction; Report 6: FINITE - A Numerical Model for Combined Refraction and Diffraction of Waves,
W87-09482 8B

CHRISTENSEN, E. J.
Aerial Deposition of Organochlorines in Urban and Coastal South Carolina,
W87-09188 5B

CHRISTIAN, S. D.
Removal of Multivalent Metal Cations from Water Using Micellular-Enhanced Ultrafiltration,
W87-09223 2K

CHRISTMAN, R. F.
By-Products of Chlorination: Specific Compounds and Their Relationship to Total Organic Halogen,
W87-09123 5F

CHUNG, D. Y.
Mobility of Sludge-Borne 3,3'-Dichlorobenzidine in Soil Columns,
W87-08925 5B

CLABORN, B. J.
Water Resources Audit for Small Communities,
W87-08953 5F

CLAIR, T. A.
Transport of Arsenic and Mercury from Gold Mining Activities Through an Aquatic System,
W87-08731 5B

CLARK, J. R.
Field Confirmation of a Laboratory-Derived Hazard Assessment of the Acute Toxicity of Fenthion to Pink Shrimp, Penaeus duorarum,
W87-08638 5C

CLARK, M. A.
1986 Lake Nyos Gas Disaster in Cameroon, West Africa,
W87-08780 2H

CLARK, R. M.
Applying Economic Principles to Small Water Systems,
W87-08955 6C

CLARKE, J. U.
Regulatory Identification of Petroleum Hydrocarbons in Dredged Material,
W87-09154 5A

CLARKE, S. E.
Induction of Siderophore Activity in Anabaena spp. and Its Moderation of Copper Toxicity,
W87-09386 5G

CLARY, C. D.
Artificial Ground Water Recharge by Flooding During Grapevine Dormancy,
W87-08979 2F

CLIFF, J. L.
Water Use and Health in Mueda, Mozambique,
W87-08777 5F

CLINE, J. D.
Processes Affecting the Distribution of Low-Molecular-Weight Aliphatic Hydrocarbons in Cook Inlet, Alaska,
W87-09506 5B

CLOSE, M. E.
Leaching Losses from Irrigated Pasture: Waiau Irrigation Scheme, North Canterbury,
W87-08737 5B

CLOTHIER, B. E.
Solute Transport During Absorption and Infiltration: A Comparison of Analytical Approximations,
W87-08990 7C

COCKFIELD, S. D.
Interaction of Euonymus scale (Homoptera:Diaspididae) Feeding Damage and Severe Water Stress on Leaff Abscission and Growth of Euonymus Fortunei,
W87-09344 2I

CODE, J. A.
Geotechnical Aspects of Corani Reservoir Enlargement,
W87-08794 8A

COHON, J. L.
Optimal Water Treatment Plant Design,
W87-09374 5F

COLBOURNE, J. S.
Presence of Legionella in London's Water Supplies,
W87-08901 5F

COLEY, K. S.
Toxicity of Aqueous Extracts of Natural and Synthetic Oils to Three Species of Lemna,
W87-08647 5C

COLMSJO, A.
Characterization of the PAC Profile in Settling Particulates from the Urban Waters of Stockholm,
W87-09237 5B

COMANS, R. N. J.
Geochemical Studies in the Drainage Basin of the Rio Vouga, Portugal. IV. Impact of Land Use on the Hydrogeochemistry of Natural Waters in the Vouzela Region,
W87-09207 4C

COMMERSCHEIDT, N.
Environmental Specimen Bank Specific Reference Materials - Main Aims and Preparation,
W87-08918 5A

COMPTON, H. R.
1986 Lake Nyos Gas Disaster in Cameroon, West Africa,
W87-08780 2H

CONLEY, L. F.
Survival and Multiplication of Legionella pneumophila in Municipal Drinking Water Systems,
W87-09389 5F

CONNELL, D. W.
Comparative Kinetics for Bioaccumulation of Polychlorinated Biphenyls by the Polychaete (Capitella capitata) and Fish (Mugil cephalus),
W87-08856 5B

COOLEY, J.
Fate of the Zoe Colocotroni Oil Spill and its Effects on Infaunal Communities Associated with Mangroves,
W87-09544 5C

COOPER, J. R.
Riparian Areas as Filters for Agricultural Sediment,
W87-09002 4A

COOPER, P. F.
Scale-Up of Biological Wastewater Treatment Processes: Practical Experiences in the U.K.,
W87-09453 5D

CORTNER, H. J.
Institutional Analysis in Community Decision-Making: A Case Example from Southern Arizona,
W87-08981 6A

COSSA, D.
Concentrations of Mercury in Near Shore Surface Waters of the Bay of Biscay and in the Gironde Estuary,
W87-08961 5A

COTRUVO, J. A.
Regulation of Contaminants In Drinking Water,
W87-09128 5F

COTTA-RAMUSINO, M.
Acute Toxicity of Brestan and Fentin Acetate on Some Freshwater Organisms,
W87-08876 5C

COTTON, W. R.
Numerical Simulation of the Effects of Varying Ice Crystal Nucleation Rates and Aggregation Processes on Orographic Snowfall,
W87-08697 2B

COWGILL, U. M.
Brood Size and Neonate Weight of Daphnia magna Produced by Nine Diets,
W87-08641 2H

COWLEY, P. J.
Information Retrieval System: Impacts of Water-Level Changes on Uses of Federal Storage Reservoirs of the Columbia River; Appendix F: RIVOPR User's Manual,
W87-09477 10B

COX, J. C.
Containment of Oil Spilled Under Rough Ice,
W87-09526 5B

COZZARELLI, I. M.
Mobilization of Aluminum in a Natural Soil System: Effects of Hydrologic Pathways,
W87-09024 5B

CRAGG-HINE, D.
Assessment of the Flow Requirements for Upstream Migration of Salmonids in Some Rivers of North-West England,
W87-09058 2H

CRAWFORD-BROWN, D. J.
Age-Dependent Lung Doses from Ingested 222Rn in Drinking Water,
W87-08844 5C

CRESSIE, N. A. C.
Robust-Resistant Spatial Analysis of Soil Water Infiltration,
W87-09029 7C

CRETNEY, W. J.
Biodegration of Chemically Dispersed Crude Oil,
W87-09512 5B

CRISP, D. T.
Effects of Impoundment and Regulation of the River Tees at Cow Green (Northern Pennines, UK) Upon Fish Populations in Afferent Tributaries and in the River Immediately Downstream of the Dam,
W87-09040 6G

CRITTENDEN, J. C.
Prediction of Fixed-Bed Adsorber Removal of Organics in Unknown Mixtures,
W87-09369 5D

CROSSMANN, G.
Trace and Nutrient Element Transfer from Sewage Sludge-Amended Soil to Crops: A Study on Brassica oleracea,
W87-08917 5B

CROWTHER, M. A.
Environmental Aspects of Energy Related Solid Waste,
W87-09427 5E

CUMMINGS, G. A.
Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: I. Persistence, Yield, Quality, and Elemental Removal,
W87-08919 5C

Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: II. Rainfall Runoff and Soil Chemical Properties,
W87-08920 5C

CUMONT, G.
Contamination of Fish from the French Zone of Lake Leman by Organochlorine Compounds between 1973 and 1981 (Contamination des Poissons du Secteur Francais du Lac Leman, par les Composes Organochlores entre 1973 et 1981),
W87-08909 2H

CUNDY, T. W.
Steady-State Analysis of Infiltration and Overland Flow for Spatially-Varied Hillslopes,
W87-08974 2E

CUSTODIO, E.
Attempts to Determine the Viability of a Deep Excavation on the Coast of the Vandellos Massif (Tarragona, Spain) (Ensayos Para Determinar la Viabilidad de una Excavacion Profunda en el Litoral del Macizo de Vandellos (Tarragona, Expana)),
W87-09574 2F

CZAPLICKI, J. S.
Tucson Aqueduct Phase B Central Arizona Project: Archaeological Data Recovery Studies, 1985-1986 Annual Report,
W87-09329 6G

CZARNEZKI, J. M.
Use of the Pocketbook Mussel, Lampsilis ventricosa, for Monitoring Heavy Metal Pollution in an Ozark Stream,
W87-08875 5A

D'AMATO, M. L.
Mercury Pollution in Marine Sediment Cores Near Cinnabar Deposits and a Chlor-Alkali Plant,
W87-08727 5B

D'ASARO, C. N.
Effects of Triethylene Glycol on Mysidopsis bahia (Crustacea: Mysidacea) and Menidia peninsulae (Pisces: Atherinidae),
W87-08644 5C

DAMIECKI, R.
Efficiency and Process: Stability of Single Stage and Multi-Stage Wastewater Treatment Plants,
W87-09452 5D

DANIEL, T. C.
Effect of Tillage System on Runoff Losses of Surface-Applied Pesticides,
W87-09001 2E

DANIELS, R. B.
Riparian Areas as Filters for Agricultural Sediment,
W87-09002 4A

DANILOVA, M. N.
Growth and Development of Rana arvalis in Conditions Imitating Oil Contamination,
W87-08713 5C

DAUBE, B.
Two New Ground-Level Cloud Water Sampler Designs Which Reduce Rain Contamination,
W87-08948 7B

DAUBLE, D. D.
Usefulness of the Lipid Index for Bioaccumulation Studies with Daphnia magna,
W87-08652 5C

DAVE, M.
Transport and Dry Deposition of Trace Metals over Southern Lake Michigan,
W87-09179 5B

DAVIDSON, C. I.
Scavenging of Atmospheric Sulfate by Arctic Snow,
W87-08947 2C

DAVIES, B. E.
Epidemiology of Dental Caries in Relation to Environmental Trace Elements,
W87-08694 5C

DAVIES-COLLEY, R. J.
Absorption of Light by Yellow Substance in Freshwater Lakes,
W87-08934 2H

DAVIES, M. S.
Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XI. Growth of Geum rivale L. and Geum urbanum L. and Soil Chemical Condition in Experimentally Flooded Soil,
W87-09398 2I

DAVIES, T.
Snow Forecasts from the Meteorlogical Office Fine-mesh Model During the Winter of 1985/86,
W87-08702 2B

DAVIES, T. D.
Effect of Polluted and Leached Snow Melt Waters on the Soil Bacterial Community--Quantitative Response,
W87-08874 5C

Spatial Variability in the Chemical Composition of Snowcover in a Small, Remote, Scottish Catchment,
W87-08945 5B

DAVIS, A. O.
Atmospheric Lead and Zinc Deposition into Lakes of the Eastern United States,
W87-09183 5B

DAVIS, E.
Factors of Scale in Rapid Sand Filtration,
W87-09440 5F

DAVIS, E. C.
Predictive Application of an ORNL Geohydrology Model,
W87-08760 7C

DAVIS, E. M.
Establishment of Biotic Communities Within a Newly Constructed Ash Settling Basin and Its Drainage System,
W87-09323 5E

DAVIS, J. L.
Time-Domain Reflectometry (TDR) and Its Application to Irrigation Scheduling,
W87-09467 3F

DAVIS, R. B.
Rates of Accumulation of Heavy Metals in Pre- and Post-European Sediments in New England Lakes,
W87-09184 5B

DAVISON, E. M.
Effect of Waterlogging on Infection of Eucalyptus marginata Seedlings by Phytophthora cinnamomi,
W87-09401 2I

DAVISON, R. W.
Supply of Snow in the Eastern Highlands of Scotland: 1954-5 to 1983-4,
W87-08810 2C

DE ANGELIS, G.
Xenobiotic-Metabolizing Enzyme Systems in Test Fish: I. Comparative Studies of Liver Microsomal Monooxygenases,
W87-08852 5C

DE DIOS LOPEZ-GONZALEZ, J.
Adsorption of 2,4,5-T by Active Carbons from Aqueous Solution,
W87-09254 5D

Study of the Kinetics of the Adsorption by Activated Carbons of 2,4,5-Trichlorophenoxyacetic Acid from Aqueous Solution,
W87-09251 5D

DE GRAAF, M.
Linear Regression Model Combined with a Soil Water Balance Model to Design Micro-Catchments for Water Harvesting in Arid Zones,
W87-08738 3B

DE LOS SANTOS, A.
Pulsed Nuclear Magnetic Resonance Instrument for Soil-Water Content Measurement: Sensor Configurations,
W87-08991 7B

DE MALACH, Y.
Irrigation with Brackish Water under Desert Conditions: IV. Salt Tolerance Studies with Lettuce (Lactuca sativa L.),
W87-08746 3C

Irrigation with Brackish Water under Desert Conditions: V. Nitrogen Requirement of Tomatoes (Lycopersicon esculentum Mill.) during Germination under Drip Irrigation,
W87-08747 3C

DE MEIR, W. V.
Information Retrieval System: Impacts of Water-Level Changes on Uses of Federal Storage Reservoirs of the Columbia River; Appendix F: RIVOPR User's Manual,
W87-09477 10B

DE SOUZA, C. M. M.
Geochemical Partitioning of Heavy Metals in Sediments of Three Estuaries Along the Coast of Rio de Janeiro (Brazil),
W87-08717 2L

DE VRIEND, H. J.
Analysis of Horizontally Two-Dimensional Morphological Evolutions in Shallow Water,
W87-08782 7C

DEAN, J. D.
Nonpoint Source Pollution Models for Chemicals,
W87-08673 5B

Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants, Part 1,
W87-09462 5B

DEAVER, K.
Cultural Resource Inventory of Fresno Reservoir, Hill County, Montana,
W87-09331 6G

DEBYSER, Y.
Geochemistry of Humic Substances in Marine Sediments,
W87-09076 2J

DECK, D. S.
Hydraulic Model Study of Port Huron Ice Control Structure,
W87-09473 2C

DECLERCQ, D. R.
Simultaneous Measurement of Primary Production by Whole-Lake and Bottle Radiocarbon Additions,
W87-08931 2H

DELLEUR, J. W.
Introduction to Urban Hydrology and Stormwater Managment,
W87-09097 4C

DEMARS, J.-J.
Repurcussion of Small Hydroelectric Power Stations on Populations of Brown Trout (Salmo trutta) in Rivers in the French Massif-Central,
W87-09041 6G

DEMERS, S.
Resuspension in the Shallow Sublittoral Zone of a Macrotidal Estuarine Environment: Wind Influence,
W87-08933 2L

DENDROU, S. A.
Overview of Urban Stormwater Models,
W87-09104 4C

DENG, J.-F.
Hydrogen Sulfide Poisonings in Hot-Spring Reservoir Cleaning: Two Case Reports,
W87-08614 5C

DEUTSCH, W. J.
Guidelines for Sampling and Analyzing Solutions from Aquifer Thermal-Energy-Storage Systems,
W87-09457 5A

DEVINE, J. D.
1986 Lake Nyos Gas Disaster in Cameroon, West Africa,
W87-08780 2H

DEVOL, A. H.
Role of Gas Exchange in the Inorganic Carbon, Oxygen, and 222Rn Budgets of the Amazon River,
W87-08871 2H

DHINDSA, R. S.
Glutathione Status and Protein Synthesis During Drought and Subsequent Rehydration in Tortula ruralis,
W87-09417 2I

DIAL, C. A. B.
Lethal Effects of Diquat and Paraquat on Developing Frog Embryos and 15-Day-Old Tadpoles, Rana pipiens,
W87-09235 5C

DIAL, N. A.
Lethal Effects of Diquat and Paraquat on Developing Frog Embryos and 15-Day-Old Tadpoles, Rana pipiens,
W87-09235 5C

DICKENS, D. F.
Dome's Petroleum Study of Oil and Gas Under Sea Ice,
W87-09525 5G

DICKS, B.
Ten Years of Saltmarsh Monitoring - The Case History of a Southampton Water Saltmarsh and a Changing Refinery Effluent Discharge,
W87-09545 5C

DIGIANO, F. A.
Biofilm Shearing Under Dynamic Conditions,
W87-09367 5D

DILBECK, R. E.
Use of Canopy Temperatures to Identify Water Conservation in Cotton Germplasm,
W87-08788 3F

DILL, D. C.
Toxicity of Picloram (4-Amino-3,5,6-Trichloropicolinic Acid) to Life Stages of the Rainbow Trout,
W87-08877 5C

DILLION, T. M.
Effects of Dimethylnaphthalene and Fluctuating Temperatures on Estuarine Shrimp,
W87-09517 5C

DILLON, P. J.
Input of Biologically Available Phosphorus by Precipitation to Precambrian Lakes,
W87-09174 5B

DINEL, H.
Downward Movement of Partly Degraded Materials in Dyked Marsh Soils,
W87-08998 2H

DINGMAN, S. L.
Fluvial Hydrology,
W87-08685 2A

DISSANAYAKE, C. B.
Heavy Metal Pollution of the Mid-Canal of Kandy: An Environmental Case Study from Sri Lanka,
W87-08840 5C

DOCHERTY, D.
Embryotoxicity, Teratogenicity, and Aryl Hydrocarbon Hydroxylase Activity in Forster's Terns on Green Bay, Lake Michigan,
W87-08841 5C

DOCI, A.
Acute Toxicity of Brestan and Fentin Acetate on Some Freshwater Organisms,
W87-08876 5C

DOKKEN, Q. R.
Effects of the Ixtoc I Oil Spill on the Intertidal and Subtidal Infaunal Populations Along Lower Texas Coast Barrier Island Beaches,
W87-09556 5C

DOKOOZLIAN, N. K.
Artificial Ground Water Recharge by Flooding During Grapevine Dormancy,
W87-08979 2F

DOLE, L. R.
Development Programs in the United States of America for the Application of Cement-Based Grouts in Radioactive Waste Management,
W87-09113 5E

DOLGOPOLOV, A. S.
Measures to Reduce the Level of Vibrations of Turbine-Generator Units,
W87-09365 8C

DOLSKE, D. A.
Transport and Dry Deposition of Trace Metals over Southern Lake Michigan,
W87-09179 5B

DONALDSON, J.R.
Outbreak of Legionnaires' Disease in Glasgow Royal Infirmary: Microbiological Aspects,
W87-08703 5C

DONGES, U.
Gas-Chromatographic Determination of Total Polychlorinated Aromates and Chloro-Paraffins Following Catalytic Reduction in the Injection Port,
W87-09260 5A

DONIGIAN, A. S.
Nonpoint Source Pollution Models for Chemicals,
W87-08673 5B

DONNELL, B. P.
Spectral Analysis of Columbia River Estuary Currents,
W87-09430 2L

DORR, J. A.
Shifting of the Kosi River, Northern India,
W87-08834 2E

DOSS, G. J.
Effect of Fertilization with Municipal Sludge on the Glutathione, Polyamine, and Cadmium Content of Cole Crops and Associated Loopers (Trichoplusia ni),
W87-08835 5C

DOSTAL, K. A.
Acute and Chronic Toxicity to the Fathead Minnow, Pimephales promelas, of Effluents from a Treatment Plant Receiving Dye and Pigment Processing Wastewater,
W87-08656 5C

DOUABUL, A. A. Z.
Organochlorine Pesticide Residues in Fish from the Shatt al-Arab River, Iraq,
W87-08880 5B

Residues of Organochlorine Pesticides in Environmental Samples from the Shatt-al-Arab River, Iraq,
W87-08910 5B

DOUGHTY, C.
Groundwater Transport: Handbook of Mathematical Models,
W87-09306 5B

DOUGLAS, G. B.
Effect of Soil Slip Erosion on Wairoa Hill Pasture Production and Composition,
W87-08734 2J

DOWDY, R. H.
Soybean Growth and Boron Distribution in a Sandy Soil Amended with Scrubber Sludge,
W87-08927 5C

DRATH, A.
Seasonality of Legionella Isolates from Environmental Sources,
W87-08902 2H

DRESSMAN, R. C.
Disinfectant Chemistry In Drinking Water - Overview of Impacts on Drinking Water Quality,
W87-09122 5F

DREWES, U.
Sri Lanka's Randenigala Project,
W87-09412 8A

DRICI, O.
Velocity Control as a Tool for Optimal Plume Containment in the Equus Beds Aquifer, Kansas,
W87-08982 5G

DU BOIS, H. L. E.
High Pressure Grouting in Deep Gold Mines,
W87-09592 4B

DU PLESSIS, D. B.
Extreme Floods in Southern Africa Caused by Tropical Cyclone Domoina,
W87-09410 2F

DUBERY, B.
Seasonality of Legionella Isolates from Environmental Sources,
W87-08902 2H

DUEDALL, I. W.
Physical and Chemical Behavior and Environmental Acceptability of Stabilized Scrubber Sludge and Fly Ash in Seawater,
W87-09327 5B

DUERDEN, F. C.
Kurdistan - An Unusual Spill Successfully Handled,
W87-09527 5G

DUFFY, C. J.
Statistical Structure and Filter Characteristics of Tritium Fluctuations in Fractured Basalt,
W87-09027 5B

DUNIPACE, A. J.
Absence of Mutagenic and Antimutagenic Activities of Fluoride in Ames Salmonella Assays,
W87-09405 5C

DUNN, R. O.
Removal of Multivalent Metal Cations from Water Using Micellular-Enhanced Ultrafiltration,
W87-09223 2K

DUNWIDDIE, P. W.
Macrofossil and Pollen Representation of Coniferous Trees In Modern Sediments from Washington,
W87-08690 2H

DUQUINO, H. H.
Antibiotic-Resistant Pseudomonas in Bottled Drinking Water,
W87-09424 5F

DURAND, J.-L.
Nitrogenase Activity, Photosynthesis and Nodule Water Potential in Soyabean Plants Experiencing Water Deprivation,
W87-08798 2I

DURBIN, R.
Scientific Considerations in the Legislative Arena,
W87-08625 6E

DURCHEVA, V. N.
Concrete Dam of the Denin Dnepr Hydroelectric Station,
W87-09352 8A

DUTTON, A. R.
Origin of Brine in the San Andres Formation, Evaporite Confining System, Texas Panhandle and Eastern New Mexico,
W87-09351 2F

DYER, K. L.
Stream Water Quality in the Coal Region of Virginia,
W87-09494 4C

DYRSSEN, D.
Stagnant Sulphidic Basin Waters,
W87-08722 2K

DZHAKELI, P. A.
Arch Dam of the Khudoni Hydroelectric Station,
W87-09353 8A

DZOMBAK, D. A.
Adsorption of Inorganic Pollutants in Aquatic Systems,
W87-09194 5B

EADES, R. T.
Evaluating Asphalt Cap Effectiveness at Superfund Site,
W87-09379 5E

EAMUS, D.
Responses of Leaf Water Potential and Leaf Diffusive Resistance to Abscisic Acid, Water Stress and Low Temperature in Hibiscus esculentus: The Effect of Water Stress and ABA Pre-Treatments,
W87-09210 2D

EASTER, K. W.
Small-Scale Surface (Tank) Irrigation in Asia,
W87-09015 3F

EASTMOND, D. A.
Comparison of QSAR Predictions with Fish Toxicity Screening Data for 110 Phenols,
W87-08637 5C

EATON, J.
Biological Effects of Continuous and Intermittent Dosing of Outdoor Experimental Streams with Chloropyrifos,
W87-08634 5C

EBEL, W. J.
Review of Effects of Environmental Degradation on the Freshwater Stages of Anadromous Fish,
W87-09042 2H

EBRIGHT, C. A.
Prehistoric Cultural Resources Study Predictive Model and Field Survey Weber Basin Project,
W87-09335 6G

ECKENFELDER, W. W.
Scale-Up of Activated Sludge and Trickling Filter Processes,
W87-09451 5D

ECKERT, T. E.
Yakima River Basin Historical Resource Survey, Volume I: Overview and Management Recommendations,
W87-09192 6G

ECONOMOPOULOS, J. N.
Problems of Water Inrush into Greek Underground Mines with Special Emphasis to Sea Water Inrush Through Karstic Limestones or Impermeable Formations,
W87-09596 2F

EDGERTON, E. S.
Atmospheric Deposition of Acidity and Sulfur in Florida,
W87-09177 5B

Atmospheric Deposition of Nitrogen and Phosphorus in Florida,
W87-09175 5B

EDINGER, J. E.
Developments in LARM2: A Longitudinal-Vertical, Time-Varying Hydrodynamic Reservoir Model,
W87-09489 8B

EDMOND, J. M.
Selenium in the Tributaries of the Orinoco in Venezuela,
W87-09406 2K

EDWARDS, R. T.
Sestonic Bacteria as a Food Source for Filtering Invertebrates in Two Southeastern Blackwater Rivers,
W87-08870 2H

EFFLER, S. W.
Effect of 'Whiting' on Optical Properties and Turbidity in Owasco Lake, New York,
W87-08966 2H

Spatial Variability in Selected Physical Characteristics and Processes in Cross Lake, New York,
W87-08973 2H

EGGLISHAW, H. J.
Afforestation and Fisheries,
W87-09061 4C

EHLERINGER, J.
Field Water Relations of a Compass Plant, Lactuca serriola L.,
W87-08772 2I

EINARSSON, K.
Transformation of Input to a Stochastic Model Using a Distribution Deterministic Model,
W87-08825 2E

EISENREICH, S. J.
Atmospheric Concentrations and Deposition of Polychlorinated Biphenyls to Lake Superior,
W87-09185 5B

Trace Metal and Strong Acid Composition of Rain and Snow in Northern Minnesota,
W87-09178 5B

EL-ARAB, A. E.
Fate of 14C-Lindane in a Rice-Fish Model Ecosystem,
W87-08915 5B

EL-ASHRY, M. T.
American West's Acid Rain Test,
W87-09160 5B

EL-JABI, N.
Flood Damage Model for Flood Plain Studies,
W87-08965 2E

ELDER, R. A.
Fish Diversion in Hydropower Intake,
W87-09197 8I

ELGAMAL, A.-W. M.
2-D Elastoplastic Seismic Shear Response of Earth Dams: Applications,
W87-08608 8A

2-D Elastoplastic Seismic Shear Response of Earth Dams: Theory,
W87-08607 8A

ELLIN, R. I.
Determination of Toxic Organophosphorus Compounds by Specific and Nonspecific Detectors,
W87-09220 5A

ELLINGTON, R. T.
Removal of Multivalent Metal Cations from Water Using Micellular-Enhanced Ultrafiltration,
W87-09223 2K

ELLISON, R. D.
Development of a Ground Water Hazard Map for an Underground Coal Mine,
W87-09585 2F

ELMER, T. H.
Recovery of Water from Atmospheric Air in Arid Climates,
W87-08601 5F

ELRICK, D. E.
Solute Transport During Absorption and Infiltration: A Comparison of Analytical Approximations,
W87-08990 7C

ELSMORE, R.
Biocidal Control of Legionellae,
W87-08904 5F

ELZERMAN, A. W.
Mechanisms of Enrichment at the Air-Water Interface,
W87-09169 5B

EMDE, W.
Role of Kinetic Models for the Scale-Up of Biological Processes,
W87-09450 5D

EMERY, B. D.
Aerial Application of Dispersants at the Ixtoc I Spill,
W87-09534 5G

ENGEL, V. E.
Measures to Reduce the Level of Vibrations of Turbine-Generator Units,
W87-09365 8C

ENGLUND, J.-O.
Profiles of Nitrogen Species in a Sand-Silt Aquifer at Haslemoen, Solor, South Norway,
W87-08818 5B

ERGAZ, M.
Exposure to Legionella in Geriatric Institutions,
W87-08907 5B

ERMOLAEVA, L. S.
Interrelationships of Algae and Bacteria During Methane Oxidation,
W87-08712 2H

ERONEN, T. K.
Restoration of the River Vaikkojoki, Finland,
W87-09046 2H

ESBENSEN, S. K.
Consistent Parameterization of the Effects of Cumulus Clouds on the Large-Scale Momentum and Vorticity Fields,
W87-08938 2B

ETHERINGTON, J. R.
Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XI. Growth of Geum rivale L. and Geum urbanum L. and Soil Chemical Condition in Experimentally Flooded Soil,
W87-09398 2I

Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XII. Growth, Photosynthetic Capacity and Metal Ion Uptake in Salix caprea and S. Cinerea ssp. Oleifolia,
W87-09399 2I

Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XIII. The Effect of Fe(2+) on Photosynthesis and Respiration of Salix caprea and S. cinerea ssp. oleifolia,
W87-09400 2I

ETHRIDGE, J. D.
Pumping Performance and Turbidity Generation of Model 600/100 Pneuma Pump: Main Text and Appendixes A and B,
W87-09487 8C

EVANS, R. G.
Control of Furrow Erosion With Crop Residues and Surge Flow Irrigation,
W87-09003 3F

EVANS, R. O.
Swine Lagoon Effluent Applied to Coastal Bermudagrass,
W87-09472 5D

EVANS, W. C.
1986 Lake Nyos Gas Disaster in Cameroon, West Africa,
W87-08780 2H

FAETH, S. H.
Impact of Irrigation and Experimental Drought Stress on Leaf-Mining Insects of Emory Oak,
W87-09402 2I

FAGERBURG, T. L.
Fixed-Cone Valve Prototype Tests, Final Series, New Melones Dam, California,
W87-09483 8C

Post-Pool Raise Spillway Prototype Test for Chief Joseph Dam Columbia River, Washington,
W87-09153 8A

FAIR, P. H.
Effect of Ingested Benzo(a)pyrene and Cadmium on Tissue Accumulation, Hydroxylase Activity, and Intestinal Morphology of the Black Sea Bass, Centropristis striata,
W87-08842 5C

FAIRER, G. M.
Basic Data Report for Drilling and Hydrologic Testing of Drillhole DOE-2 at the Waste Isolation Pilot Plant (WIPP) Site,
W87-09333 5E

FALLON, R. D.
Use of Monodispersed, Fluorescently Labeled Bacteria to Estimate In Situ Protozoan Bacterivory,
W87-09388 2H

FALLON, R. J.
Outbreak of Legionnaires' Disease in Glasgow Royal Infirmary: Microbiological Aspects,
W87-08703 5C

FANNIN, T. E.
Effect of Beaver Ponds on the Nonpoint Source Water Quality of a Stream in Southwestern Wyoming,
W87-09265 2H

FARLOW, J. S.
Distribution of Aromatic Hydrocarbons in Port Valdez, Alaska,
W87-09513 5B

Effectiveness of Offshore Produced Water Treatment,
W87-09515 5D

FARNHAM, R. S.
Geochemistry of Humic Substances in Natural and Cultivated Peatlands,
W87-09069 2H

FATTAL, B.
Seasonal Distribution of Legionellae Isolated from Various Types of Water in Israel,
W87-08903 5A

FAUST, S. D.
Chemistry of Natural Waters,
W87-09149 2K

FAY, W. M.
Orientation Study of St. Francois Mountain and Decaturville Precambrian Areas, Missouri,
W87-09459 2K

Seasonal Effects on Ground-Water Chemistry of the Ouachita Mountains,
W87-09428 2K

FEDDES, R. A.
Linear Regression Model Combined with a Soil Water Balance Model to Design Micro-Catchments for Water Harvesting in Arid Zones,
W87-08738 3B

FEE, E. J.
Simultaneous Measurement of Primary Production by Whole-Lake and Bottle Radiocarbon Additions,
W87-08931 2H

FELLER, R. J.
Immunological Dietary Analysis of Two Penaeid Shrimp Species from a South Carolina Tidal Creek,
W87-08988 2L

FENDINGER, N. J.
Microbially Mediated Leaching of Low-Sulfur Coal in Experimental Coal Columns,
W87-09393 5B

FERNANDES, M. I. A. P.
Applications of Porous Membranes for Biomass Retention in Biological Wastewater Treatment Processes,
W87-08889 5D

FERNANDEZ, M. A.
Residues of Organochlorine Chemicals and Concentrations of Heavy Metals in Ciconiforme Eggs in Relation to Diet and Habitat,
W87-08916 5B

FERNANDEZ-RUBIO, R.
Hydrogeological Problems Affecting the Exploitation of the Peat Bog at Padul (Granad, Spain). Preliminary Study (Problemas Hidrogeologicos que Afectan a la Explotacion de la Turbera de Padul (Granad, Espana). Estudio Preliminar),
W87-09576 4A

FERRIS, D. M.
Leaf Photosynthesis and Conductance of Selected Triticum Species at Different Water Potentials,
W87-09419 2I

FIELD, J. A.
Methanogenic Toxicity and Anaerobic Degradability of a Hydrolyzable Tannin,
W87-09278 5D

FINKEL, H. J.
Agronomic Measures for Soil and Water Conservation,
W87-08664 3F

Engineering Measures for Soil and Water Conservation: Terracing and Benching,
W87-08667 3F

Engineering Measures: Water Harvesting,
W87-08668 3F

Engineering Measures: Waterways and Diversion Channels,
W87-08666 8A

Gulley Control,
W87-08669 3F

Hydrology,
W87-08662 2A

Semiarid Soil and Water Conservation,
W87-08661 3F

Soil Erosion Process,
W87-08663 2J

FINKEL, M.
Engineering Measures: Water Harvesting,
W87-08668 3F

Hydrology,
W87-08662 2A

FINKELSTEIN, K. J.
Impact and Persistence of Ixtoc I Oil on the South Texas Coast,
W87-09557 5C

FISZMAN, M.
Heavy Metal Pollution in the Paraiba do Sul River, Brazil,
W87-08718 5B

FITZGERALD, D. E.
1979 Southern California Dispersant Treated Research Oil Spills,
W87-09536 5G

FITZGERALD, G. J.
Salinity During Embryonic Development Influences the Response to Salinity of Gasterosteus Aculeatus L. (Trachurus),
W87-08793 2H

FLAUGNATTI, R.
Toxicity and Bioaccumulation of Cadmium in Experimental Cultures of Duckweed, Lemna polyrrhiza L.,
W87-09241 5C

FLEURETTE, J.
Epidemiological Evidence of Legionellosis Transmission through Domestic Hot Water Supply Systems and Possibilities of Control,
W87-08905 5F

FOLSOM, B. L.
Field Survey of Heavy Metal Uptake by Naturally Occurring Saltwater and Freshwater Marsh Plants,
W87-09490 5B

FORESTER, J.
Effects of Triethylene Glycol on Mysidopsis bahia (Crustacea: Mysidacea) and Menidia peninsulae (Pisces: Atherinidae),
W87-08644 5C

FORLIN, L.
Long-Term Effects of Bleached Kraft Mill Effluents on Carbohydrate Metabolism and Hepatic Xenobiotic Biotransformation Enzymes in Fish,
W87-08854 5C

FORTIN, J. P.
Application of Meteorological Radar Data for Simulation of Streamflow with a Hydrological Matrix Model (Utilisation des Donnees d'un Radar Meteorologique pour la Simulation des Ecoulements en Riviere a l'aide d'un Modele Hydrologique Matriciel),
W87-08623 7B

FORTNER, A. R.
Effect of Ingested Benzo(a)pyrene and Cadmium on Tissue Accumulation, Hydroxylase Activity, and Intestinal Morphology of the Black Sea Bass, Centropristis striata,
W87-08842 5C

FOSTER, R. B.
Environmental Legislation,
W87-09299 6E

Use of Asiatic Clam Larvae in Aquatic Hazard Evaluations,
W87-09326 5C

FOSTER, S. S. D.
British Examples of a Hydrogeological Approach to the Evaluation of Drainage Problems in Subsurface Engineering,
W87-09593 2F

FOUFOULA-GEORGIOU, E.
Error Analysis of Conventional Discrete and Gradient Dynamic Programming,
W87-09023 7C

Markov Renewal Model for Rainfall Occurrences,
W87-09025 7C

FRANKE, O. L.
Alternate Procedure for Analyzing Aquifer Tests Using the Theis Nonequilibrium Solution,
W87-08756 7C

FREEMAN, H. C.
Effects of an Acidic River, Caused by Acidic Rain, on Weight Gain, Steroidogenesis, and Reproduction in the Atlantic Salmon (Salmo salar),
W87-08651 5C

FREEMAN, R. A.
Environmental Mobility of Dioxins,
W87-08658 5B

FREMLING, C. R.
Impacts of a Spill of No. 6 Fuel Oil on Lake Winona,
W87-09551 5C

FRENCH, P. N.
Interactive Computer-Aided Water Resources and Environmental Planning Using Color Raster Graphics: Program Description and User's Guide,
W87-09426 7C

FRENCH, R. H.
Open-Channel Hydraulics,
W87-08688 8B

FREVERT, T.
Heavy Metals in Lake Kinneret (Israel): II. Hydrogen Sulfide Dependent Precipitation of Copper, Cadmium, Lead and Zinc,
W87-08761 2H

FREYSTEINSSON, S.
Groundwater Modelling for Hydropower Development in Iceland,
W87-08829 2F

FRIND, E. O.
Simulation of the Borden Plume Using the Alternating Direction Galerkin Technique,
W87-09030 5B

FRITZ, F.
Protection of the Karstic Springs System in Golubinka Against Contamination by the Sea Water (la Protection du Systeme des Sources Karstiques de Golubinka Contre la Contamination par la Mer),
W87-09582 4B

FRITZ, J. S.
Determination of Cobalt, Copper, Mercury, and Nickel as Bis(2-hydroxyethyl)dithiocarbamate Complexes by High-Performance Liquid Chromatography,
W87-08831 5A

FUJITA, K.
Laboratory Experiment on the Role of Grass for Infiltration and Runoff Processes,
W87-08622 2A

FUKUHARA, H.
Enhancement of Inorganic Nitrogen and Phosphate Release from Lake Sediment by Tubificid Worms and Chironomid Larvae,
W87-09404 2H

FUNARI, E.
Xenobiotic-Metabolizing Enzyme Systems in Test Fish: I. Comparative Studies of Liver Microsomal Monooxygenases,
W87-08852 5C

FURST, M.
Introduction of Mysis relicta in Sweden: Effects on Fish in Impounded Lakes,
W87-09057 2H

FYTIANOS, K.
Correlation of Some Organic Pollution Factors in Water Systems in Northern Greece,
W87-09264 5B

GAJRI, P. R.
Synthesis of a Simplified Water Use Simulation Model for Predicting Wheat Yields,
W87-09028 2I

GALLORINI, M.
Trace and Nutrient Element Transfer from Sewage Sludge-Amended Soil to Crops: A Study on Brassica oleracea,
W87-08917 5B

GALLOWAY, J. N.
Atmospheric Lead and Zinc Deposition into Lakes of the Eastern United States,
W87-09183 5B

GAMMON, J. R.
Role of Electrofishing in Assessing Environmental Quality of the Wabash River,
W87-09328 5A

GANCZARCZYK, J. J.
Stroboscopic Determination of Settling Velocity, Size and Porosity of Activated Sludge Flocs,
W87-09263 7B

GANNON, K.
Removal of Antimony from Aqueous Systems,
W87-08604 5F

GARBER, R. W.
Chemistry of Tension Lysimeter Water and Lateral Flow in Spruce and Hardwood Stands,
W87-08926 5B

GARCIA-RODRIGUEZ, A.
Adsorption of 2,4,5-T by Active Carbons from Aqueous Solution,
W87-09254 5D

Study of the Kinetics of the Adsorption by Activated Carbons of 2,4,5-Trichlorophenoxyacetic Acid from Aqueous Solution,
W87-09251 5D

GARDE, R. J.
Mechanics of Sediment Transportation and Alluvial Stream Problems,
W87-09337 2J

GARDNER, E. A.
Groundwater Recharge and Discharge Response to Rainfall on a Hillslope,
W87-08706 2F

GARDNER, L. R.
Sedimentation and Bioturbation in a Salt Marsh as Revealed by 210Pb, 137Cs, and 7Be Studies,
W87-08932 2L

GARNAS, R. L.
Interlaboratory Comparison of the ASTM Bioconcentration Test Method Using the Eastern Oyster,
W87-08645 5A

GARNIER, J.
Toxicity and Bioaccumulation of Cadmium in Experimental Cultures of Duckweed, Lemna polyrrhiza L.,
W87-09241 5C

GASOL, J. M.
Ecology of a Cryptomonas phaseolus Population Forming a Metalimnetic Bloom in Lake Ciso, Spain: Annual Distribution and Loss Factors,
W87-08930 2H

GASTE, J.
Gas Chromatographic Analysis of Volatile Compounds in Water and Biological Samples with an Automatic Injector,
W87-09012 7B

GATES, J.
Evaluation of Oil Spill Dispersant Testing Requirements,
W87-09508 5G

GEE, G. W.
Measurement of Water Potential in Low-Level Waste Management,
W87-09456 7B

GEHRING, G. O.
Unique Inland Oil Spill - Glenrock, Wyoming,
W87-09532 5G

GELBER, R. D.
Statistical Analysis,
W87-09284 5C

GELDREICH, E. E.
Committee Report: Microbiological Considerations for Drinking Water Regulation Revisions,
W87-08959 5F

Occurrence, Significance, and Detection of Klebsiella in Water Systems,
W87-08958 5A

GELLER, G. N.
Temperature Modelling of Wet and Dry Desert Soils,
W87-08791 2G

GENTIL, S.
Ecological Modelling of a High Mountain Reservoir in Relation to Particulate Organic Matter Loading,
W87-08786 2H

GEORGE, D. G.
Catchment Effects on the Horizontal Distribution of Phytoplankton in Five of Scotland's Largest Freshwater Lochs,
W87-08790 2H

GERBER, R. P.
Fate of the Zoe Colocotroni Oil Spill and its Effects on Infaunal Communities Associated with Mangroves,
W87-09544 5C

GERSCH, F. M.
Sensitivity of Chronic Endpoints Used in Daphnia Magna Straus Life-Cycle Tests,
W87-08642 5C

GERTLER, A. W.
SO2 Oxidation in Cloud Drops Containing NaCl or Sea Salt as Condensation Nuclei,
W87-08950 6E

GERTZ, S. M.
Method for Evaluating the Impact of Radioactivity on Phytoplankton,
W87-09317 5C

GETTER, C. D.
Effects of Oil Spills on Mangrove Forests: A Comparison of Five Oil Spill Sites in the Gulf of Mexico and the Caribbean Sea,
W87-09558 5C

Mapping the Distribution of Protected and Valuable, Oil-Sensitive Coastal Fish and Wildlife,
W87-09540 7A

GHERINI, S. A.
Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants, Part 1,
W87-09462 5B

GHIORSE, W. C.
Distribution of Protozoa in Subsurface Sediments of a Pristine Groundwater Study Site in Oklahoma,
W87-09395 2H

GIBSON, A. B.
Regulatory Identification of Petroleum Hydrocarbons in Dredged Material,
W87-09154 5A

GIBSON, D. D.
Measurement of Water Potential in Low-Level Waste Management,
W87-09456 7B

GIESY, J. P.
Multispecies Tests: Research Needs to Assess the Effects of Chemicals on Aquatic Life,
W87-08632 5A

GIGER, W.
Simultaneous Determination of Linear Alkylbenzenesulfonates, Alkylphenol Polyethoxylates, and Nonylphenol by High-Performance Liquid Chromatography,
W87-09343 5A

GIGLIELLO, K. A.
Groundwater-Leachate: Modeling/Monitoring/Sampling,
W87-09089 5B

GILBERT, R. G.
Significance of Oxygen Transfer Variables in the Sizing of Dome Diffuser Aeration Equipment,
W87-09438 5D

GILBERT, T. R.
Analytical Chemistry,
W87-09295 5B

GILFILLIAN, E. S.
Fate of the Zoe Colocotroni Oil Spill and its Effects on Infaunal Communities Associated with Mangroves,
W87-09544 5C

GILLIAM, J. W.
Riparian Areas as Filters for Agricultural Sediment,
W87-09002 4A

GILLILAND, M. W.
Geographic Information System to Predict Non-Point Source Pollution Potential,
W87-08977 7A

GILLINGHAM, A. G.
Soil Water Balance Model for Sloping Land,
W87-08735 2A

GIMENEZ, S. M. N.
Role of Cupric Ions in the Generation of Superoxide in Natural Waters,
W87-08716 2K

GIORDANO, P. M.
Attenuation of Cd and Pb Solubility in Municipal Waste Incinerator Ash,
W87-08776 5E

GIZYNSKI, W.
Application of New Chemical Grouts in Strengthening and Sealing of Soils,
W87-09594 8G

GLADKOV, M. G.
Determination of the Ice Load on Elements of Marine Hydraulic Structures,
W87-09359 8A

GLOOSCHENKO, W. A.
Use of Bog Vegetation as a Monitor of Atmospheric Input of Metals,
W87-09182 5C

GLOSS, S. P.
Comparison of Toxicity Tests Conducted in the Laboratory and in Experimental Ponds using Cadmium and the Fathead Minnow (Pimephales promelas),
W87-09272 5C

GLOTFELTY, D. E.
Pesticides in Fog,
W87-09229 5B

GLYER, D.
Production Functions for Water Delivery Systems: Analysis and Estimation Using Dual Cost Function and Implicit Price Specifications,
W87-09014 6D

GNATOWSKI, M.
Application of New Chemical Grouts in Strengthening and Sealing of Soils,
W87-09594 8G

GOCHFELD, M.
Heavy Metal Concentrations in the Liver of Three Duck Species: Influence of Species and Sex,
W87-09380 5B

GOINS, D. L.
Embankment Dam Instrumentation Manual,
W87-09157 8A

GOLDMAN, K. R.
Development of a Flaring Burner Oil Disposal System,
W87-09560 5D

GOLDMAN, S. J.
Erosion and Sediment Control Handbook,
W87-08686 4D

GOLLDIN, A. L.
Determination of the Ice Load on Elements of Marine Hydraulic Structures,
W87-09359 8A

GOMEZ-JIMENEZ, I.
Adsorption of 2,4,5-T by Active Carbons from Aqueous Solution,
W87-09254 5D

Study of the Kinetics of the Adsorption by Activated Carbons of 2,4,5-Trichlorophenoxyacetic Acid from Aqueous Solution,
W87-09251 5D

GONS, H. J.
Distribution of Particulate Matter in Relation to the Thermal Cycle in Lake Vechten (The Netherlands): The Significance of Transportation Along the Bottom,
W87-09275 2H

GONZALEZ, M. J.
Residues of Organochlorine Chemicals and Concentrations of Heavy Metals in Ciconiforme Eggs in Relation to Diet and Habitat,
W87-08916 5B

GOODRICH, L. E.
Measurement of Soil Water Content Using the Combined Time-Domain Reflectometry - Thermal Conductivity Probe,
W87-08796 2G

GORDIN, I. V.
Dependence of River Pollution on Streamflow Regulation by Reservoirs,
W87-09361 5G

GORGAN, J. M.
Management of Industrial Pollutants by Anaerobic Processes,
W87-09190 5D

GORHAM, E.
Trace Metal and Strong Acid Composition of Rain and Snow in Northern Minnesota,
W87-09178 5B

GORSHKOV, Y. M.
Detection of Defects in a Grout Curtain by Geophysical Methods,
W87-09358 8E

GOSTOMSKI, F. E.
Water Quality Criteria: Protection of Use Perspective,
W87-08629 5G

GOUNARIDOU, X.
Correlation of Some Organic Pollution Factors in Water Systems in Northern Greece,
W87-09264 5B

GOUPIL, D. W.
Sampling and Composition of the Surface Microlayer,
W87-09173 5A

GOVERE, J. M.
Knowledge Attitudes and Practices in Relation to Schistosomiasis in a Rural Community,
W87-08778 5F

GRADWELL, M. W.
Variation of the Subsoil Hydraulic Conductivities of Some New Zealand Soils with Changes in Water Tension,
W87-08736 2G

GRADY, J.
Archaeological and Historical Surveys of Selected Portions of the Umatilla Basin Project, Umatilla County, Oregon,
W87-09425 6G

GRASSO, G.
'Spray-Column' Laboratory Apparatus for Organic Matter Extraction from Sludges,
W87-08913 5A

GRECO, S.
Water Vapor Transport Over the Indian Ocean During the 1979 Summer Monsoon. Part I: Water Vapor Fluxes,
W87-08937 2B

GREEN, D.
Oil Spill Cleanup with Dispersants: A Boomed Oil Spill Experiment,
W87-09535 5G

GREEN, D. R.
Biodegration of Chemically Dispersed Crude Oil,
W87-09512 5B

GREEN, M.
Settlement, Subsistence, and Specialization in the Northern Periphery: Research Design for Mitigative Data Recovery at Sites in the New Waddell Dam Borrow Areas,
W87-09094 6G

GREENBERG, A. E.
Committee Report: Microbiological Considerations for Drinking Water Regulation Revisions,
W87-08959 5F

GREENWALT, R. N.
Point Probability Distributions of Frozen Soil,
W87-08696 2C

GREER, H.
Effect of 'Whiting' on Optical Properties and Turbidity in Owasco Lake, New York,
W87-08966 2H

GREGER, M.
Effects of Cd(2+) and EDTA on Young Sugar Beets (Beta vulgaris). II. Net Uptake and Distribution of Mg(2+), Ca(2+), and Fe(2+)/Fe(3+),
W87-09228 2I

GREGORY, M.
Use of Bog Vegetation as a Monitor of Atmospheric Input of Metals,
W87-09182 5C

GRIFFITHS, R. A.
Flow Around Spill Cleanup Devices,
W87-09561 5G

GRIMVALL, A.
Removal of Individual Off-Flavour Compounds in Water During Artificial Groundwater Recharge and During Treatment by Alum Coagulation/Sand Filtration,
W87-09267 5F

Systematic Approach to Adsorption on XAD-2 Resin for the Concentration and Analysis of Trace Organics in Water Below the (mu)g/l Level,
W87-09011 5A

GROSHEV, M. E.
Considertion of the Stress-Strain State in Calculations of Slope Stability of Earth Dams,
W87-09356 8D

GROSS, G. T.
Dolores Archaeological Program: Anasazi Communities at Dolores: Early Anasazi Sites in the Sagehen Flats Area,
W87-09330 6G

GROWITZ, D. J.
Hydrogeologic Factors that May Affect Mine Drainage in the Anthracite Region of Pennsylvania, Eastern United States,
W87-09577 4C

GUCINSKI, H. AND
Sampling and Composition of the Surface Microlayer,
W87-09173 5A

GUDERLEY, H.
Salinity During Embryonic Development Influences the Response to Salinity of Gasterosteus Aculeatus L. (Trachurus),
W87-08793 2H

GUERRERO, R.
Ecology of a Cryptomonas phaseolus Population Forming a Metalimnetic Bloom in Lake Ciso, Spain: Annual Distribution and Loss Factors,
W87-08930 2H

GUERTIN, D. P.
Use of Topological Information in Hydrograph Estimation,
W87-08976 2E

GUISE-BROWN, F. H.
Water Hazard in Deep Gold Mining of the Far West Witwatersrand - South Africa,
W87-09588 2F

GULBRANDSEN, L. F.
Low Freshwater Inflow Study: Chesapeake Bay Hydraulic Model Investigation,
W87-09484 2L

GUNDLACH, E. R.
Impact and Persistence of Ixtoc I Oil on the South Texas Coast,
W87-09557 5C

GUNNISON, D.
Development of a Simplified Column Test for Evaluation of Thickness of Capping Material Required to Isolate Contaminated Dredged Material,
W87-09091 5G

GUSKOV, G. D.
Model of Stability of Revetments of Earth Spillway Slopes,
W87-09357 8D

GUTELMACHER, B. L.
Trophic Interactions in the Plankton of Malyi Sevan in July, 1984,
W87-09219 2H

GUTHRIE, P. A.
Manual of Stream Channelization Impacts on Fish and Wildlife,
W87-09497 6G

GUTHRIE, R. K.
Establishment of Biotic Communities Within a Newly Constructed Ash Settling Basin and Its Drainage System,
W87-09323 5E

GUVEN, O.
Performance and Analysis of Aquifer Tracer Tests with Implications for Contaminant Transport Modeling - A Project Summary,
W87-08759 5B

HAAS, C. N.
Committee Report: Microbiological Considerations for Drinking Water Regulation Revisions,
W87-08959 5F

HAGER, W. H.
Lateral Outflow over Side Weirs,
W87-09196 8A

HALDORSEN, S.
Profiles of Nitrogen Species in a Sand-Silt Aquifer at Haslemoen, Solor, South Norway,
W87-08818 5B

HAMA, T.
Pattern of Organic Matter Production by Natural Phytoplankton Population in a Eutrophic Lake 1. Intracellular Products,
W87-08767 2H

HAMELINK, J. L.
Bioaccumulation,
W87-09296 5B

Role of Electrofishing in Assessing Environmental Quality of the Wabash River,
W87-09328 5A

HAMILL, L.
Groundwater Resource Development,
W87-09148 6D

HAMILTON, W. S.
Defending Our LakeShores,
W87-08674 4D

HAMLIN, S. N.
Hydraulic/Chemical Changes During Ground-Water Recharge by Injection,
W87-08751 5B

HAMMAR, J.
Introduction of Mysis relicta in Sweden: Effects on Fish in Impounded Lakes,
W87-09057 2H

HAMMON, O.
Snow Forecasts from the Meteorlogical Office Fine-mesh Model During the Winter of 1985/86,
W87-08702 2B

HAMPARIAN, V. V.
Multiyear Study of Sludge Application to Farmland: Prevalence of Bacterial Enteric Pathogens and Antibody Status of Farm Families,
W87-09394 5C

HAND, D. W.
Prediction of Fixed-Bed Adsorber Removal of Organics in Unknown Mixtures,
W87-09369 5D

HANDA, A. K.
Hormonal Regulation of Protein Synthesis Associated With Salt Tolerance in Plant Cells,
W87-09227 2I

HANDA, N.
Pattern of Organic Matter Production by Natural Phytoplankton Population in a Eutrophic Lake 1. Intracellular Products,
W87-08767 2H

HANEMANN, W. M.
Estimating the Value of Water Quality Improvements in a Recreational Demand Framework,
W87-09033 6C

HANF, R. W.
Usefulness of the Lipid Index for Bioaccumulation Studies with Daphnia magna,
W87-08652 5C

HANKS, R. J.
Field Method for Estimating Hydraulic Conductivity and Matric Potential-Water Content Relations,
W87-08993 2G

HANN, R. W.
Surveillance, Tracking, and Model Correlation of the Spill from the Tanker Burmah Agate,
W87-09520 7B

HANNAH, R. P.
Ixtoc I Oil Spill - The Damage Assessment Program and Ecological Impact,
W87-09554 5C

HANSEN, E. B.
Use of Bullfrogs (Rana catesbeiana) as Biological Markers for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin Contamination in the Environment,
W87-08733 5A

HANSEN, S.
Fate of the Zoe Colocotroni Oil Spill and its Effects on Infaunal Communities Associated with Mangroves,
W87-09544 5C

Spatial Variability of Soil Water and Evapotranspiration,
W87-08815 2G

HANSON, H. F.
Occurence of Contamination In Drinking Water From Groundwater Sources,
W87-09125 5B

HANSON, S. A.
Acute Toxicity of Chlorine on Freshwater Organisms: Time-Concentration Relationships of Constant and Intermittent Exposures,
W87-08640 5C

HARA, M.
Suppression of Phosphate Liberation from Sediment by Using Iron Slag,
W87-09273 5G

HARALDSTAD, O.
Lake Effect on Stream Living Brown Trout (Salmo trutta),
W87-08763 2H

HARDER, H. W.
Aerial Deposition of Organochlorines in Urban and Coastal South Carolina,
W87-09188 5B

HARDIG, J.
Long-Term Effects of Bleached Kraft Mill Effluents on Carbohydrate Metabolism and Hepatic Xenobiotic Biotransformation Enzymes in Fish,
W87-08854 5C

HARDY, J. T.
Short-Term Effects of Polynuclear Aromatic Hydrocarbons on Sea-Surface Microlayer Phytoneuston,
W87-09238 5C

HARKER, T. L.
Federal Protection of Groundwater,
W87-09129 5G

Regulatory Flexibility and Consumer Options Under the Safe Drinking Water Act,
W87-09131 5F

HARREL, R. C.
Effects of Oil Spill Cleanup Techniques on a Salt Marsh,
W87-09548 5C

HARRIS, G. D.
Potassium Ferrioxalate as Chemical Actinometer in Ultraviolet Reactors,
W87-09377 5F

HARRISON, F. L.
New Method for Determining the Concentrations of Volatile Organic Compounds in Sediment Interstitial Water,
W87-09233 5A

HARRISON, J.
Statistical Structure and Filter Characteristics of Tritium Fluctuations in Fractured Basalt,
W87-09027 5B

HARRISON, J. L.
Measuring Fish Lengths from Instant Photographs Using a Digitizing Tablet and Minicomputer,
W87-08649 7B

HARTE, J.
American West's Acid Rain Test,
W87-09160 5B

HARTZ, K. E.
Metal Precipitation in Two Landfill Leachates,
W87-09368 5G

HARVEY, G. R.
Geochemistry of Humic Substances in Seawater,
W87-09075 2L

HASEGAWA, P. M.
Hormonal Regulation of Protein Synthesis Associated With Salt Tolerance in Plant Cells,
W87-09227 2I

HASSEL, J. H. V.
New Approach for Regulating Iron in Water Quality Standards,
W87-08636 5G

HATA, N.
Spectrophotometric Determination of Traces of Silicon in Water after Collection as Silicomolybdenum Blue on an Organic-Solvent-Soluble Membrane Filter,
W87-08833 5A

HATCHER, P. G.
Geochemistry of Humin,
W87-09077 2H

HATFIELD, J. L.
Use of Canopy Temperatures to Identify Water Conservation in Cotton Germplasm,
W87-08788 3F

HAWKINS, R. H.
Steady-State Analysis of Infiltration and Overland Flow for Spatially-Varied Hillslopes,
W87-08974 2E

HAYDEN, P. L.
Determination of Monomeric and Polynuclear Aluminum(III) Species and Hydrolysis Constants,
W87-08611 1B

HAYES, M. H. B.
Extraction of Humic Substances from Soil,
W87-09079 7B

HE, X.
Quantitative and Qualitative Aspects of Fish Crop in Relation to Environmental Quality,
W87-08855 5C

HEATON, R. C.
Leaching Behaviors of Low-Sulfur Coals and Coal Wastes from Three Western Coal Preparation Plants,
W87-09429 5B

HEATON, T. H. E.
15N/14N Ratios of Nitrate and Ammonium in Rain at Pretoria, South Africa,
W87-08944 2B

HEBERT, P. D. N.
Ecological and Physiological Differentiation Among Low-Arctic Clones of Daphnia Pulex,
W87-08691 2H

HECKMAN, J. R.
Residual Effects of Sewage Sludge on Soybean: I. Accumulation of Heavy Metals,
W87-08921 5C

Residual Effects of Sewage Sludge on Soybean: II. Accumulation of Soil and Symbiotically Fixed Nitrogen,
W87-08922 5C

HEDIN, L. O.
Decrease in Precipitation Acidity Resulting From Decreased S04(2-) Concentration,
W87-09348 5B

HEIDARI, M.
Velocity Control as a Tool for Optimal Plume Containment in the Equus Beds Aquifer, Kansas,
W87-08982 5G

HEIKINHEIMO-SCHMID, O.
Food of Whitefish (Coregonus lavaretus) in Two Neighbouring Lakes, One Regulated and the Other Natural,
W87-09055 2H

HEINANEN, A.
Three Day Study of the Diel Behaviour of Plankton in a Highly Humic and Steeply Stratified Lake,
W87-08766 2H

HEINKE, G. W.
Scaling-Up Studies on Wastewater Sedimentation,
W87-09441 5D

HEITHOLT, J. J.
Leaf Photosynthesis and Conductance of Selected Triticum Species at Different Water Potentials,
W87-09419 2I

HELGASON, S.
Groundwater Modelling for Hydropower Development in Iceland,
W87-08829 2F

HELLER, L.
Influence of Simulated Acidic Rain on Vegetative and Reproductive Tissues of Cucumber (Cucumis sativus L.),
W87-09232 5C

HELMS, J. W.
Limnological Investigations: Lake Koocanusa, Montana; Part 3: Basic Data, Post-Impoundment, 1972-1978,
W87-09463 2H

HEMKER, C. J.
Unsteady Flow to Wells in Layered and Fissured Aquifer Systems,
W87-08618 2F

HEMMER, G. L.
SCPP Meteorological and Statistical Support for Period 1 September 1985, 31 August 1986, Volume I: Interim Progress Report,
W87-09334 2B

HENDERSON, D. W.
Effects of Water Stress on Flowering and Fruit Set in Processing-Tomatoes,
W87-08770 2I

HENDRICKS, J. C.
New Approach for Regulating Iron in Water Quality Standards,
W87-08636 5G

HENDRICKS, J. D.
Histopathology,
W87-09290 5C

HENDRICKSON, W. H.
Hydrology, Water Chemistry and Ecological Relations in the Raised Mound of Cowles Bog,
W87-08837 2H

HENDRY, C. D.
Atmospheric Deposition of Acidity and Sulfur in Florida,
W87-09177 5B

Atmospheric Deposition of Nitrogen and Phosphorus in Florida,
W87-09175 5B

HENKE, M.
Association between Legionella pneumophila and Amoebae in Water,
W87-08906 5F

HEORNSTEN, A.
Influence on the Groundwater Conditions in a Multilayered Aquifer System by Alum-Shale Mining,
W87-09570 5C

HERMAN, J. S.
Mobilization of Aluminum in a Natural Soil System: Effects of Hydrologic Pathways,
W87-09024 5B

HERMANSEN, H.
Physical Structure and Brown Trout (Salmo trutta fario) Populations in Small Danish Lowland Streams,
W87-09059 2H

Review of Brown Trout (Salmo trutta) Spawning Beds, Indicating Methods for their Re-establishment in Danish Lowland Rivers,
W87-09047 2H

HERMANUTZ, R.
Biological Effects of Continuous and Intermittent Dosing of Outdoor Experimental Streams with Chloropyrifos,
W87-08634 5C

HERNANDEZ, L. M.
Residues of Organochlorine Chemicals and Concentrations of Heavy Metals in Ciconiforme Eggs in Relation to Diet and Habitat,
W87-08916 5B

HERRICKS, E. E.
Environmental Impact Analysis of Aquatic Ecosystems Using Rational Threshold Value Methodologies,
W87-09313 5C

HERRMANN, J. G.
Evaluating Asphalt Cap Effectiveness at Superfund Site,
W87-09379 5E

HESS, C. T.
Rates of Accumulation of Heavy Metals in Pre- and Post-European Sediments in New England Lakes,
W87-09184 5B

HETRICK, D. M.
Simulation of the Hydrologic Cycle for Watersheds,
W87-09111 2A

HICKMAN, J. R.
Drinking Water: A Global Victual,
W87-09116 5C

World Health Organization and Guidelines and European Economic Community Directives,
W87-09130 6E

HILEMAN, F. D.
Physical/Chemical Properties of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin,
W87-08657 5B

HILL, C.
Introduction of Mysis relicta in Sweden: Effects on Fish in Impounded Lakes,
W87-09057 2H

HINO, M.
Laboratory Experiment on the Role of Grass for Infiltration and Runoff Processes,
W87-08622 2A

HITE, J. E.
Pumping Performance and Turbidity Generation of Model 600/100 Pneuma Pump: Main Text and Appendixes A and B,
W87-09487 8C

HODGES, S. C.
Kinetics of Sulfate Adsorption and Desorption by Cecil Soil Using Miscible Displacement,
W87-08995 2G

HODSON, R. E.
Degradation of Aniline and Chloroanilines by Sunlight and Microbes in Estuarine Water,
W87-09271 5B

HOFF, J. C.
Committee Report: Microbiological Considerations for Drinking Water Regulation Revisions,
W87-08959 5F

HOFFMAN, D. J.
Embryotoxicity, Teratogenicity, and Aryl Hydrocarbon Hydroxylase Activity in Forster's Terns on Green Bay, Lake Michigan,
W87-08841 5C

HOFNER, R.
Induction of Crassulacean Acid Metabolism in Mesembryanthemum crystallinum by High Salinity: Mass Increase and de Novo Synthesis of PEP-Carboxylase,
W87-09418 3C

HOKKANEN, G. E.
Simulation of the Borden Plume Using the Alternating Direction Galerkin Technique,
W87-09030 5B

HOLLADAY, N. C.
Concrete Temperature Control During Dam Construction,
W87-09408 8F

HOLLAND, J. P.
Effects of Storage Reallocation on Thermal Characteristics of Cowanesque Lake, Pennsylvania: Numerical Model Investigation,
W87-09485 2H

Investigation and Discussion of Techniques for Hypolimnion Aeration/Oxygenation,
W87-09481 5G

HOLLAND, T. C.
Use of Silica-Fume Concrete to Repair a Stilling Basin,
W87-09413 8F

HOLLOD, G. J.
Atmospheric Concentrations and Deposition of Polychlorinated Biphenyls to Lake Superior,
W87-09185 5B

HOLM, T.
Life Cycles of Four Species of Baetis (Ephemeroptera) in Three Danish Streams,
W87-08764 2H

HOLUB, H. A.
Regulatory Dilemmas Ensnare Arizona's Small Water Companies,
W87-08952 5F

HONRATH, R. E.
Scavenging of Atmospheric Sulfate by Arctic Snow,
W87-08947 2C

HOPKINS, D. L.
Brood Size and Neonate Weight of Daphnia magna Produced by Nine Diets,
W87-08641 2H

Sensitivity of Chronic Endpoints Used in Daphnia Magna Straus Life-Cycle Tests,
W87-08642 5C

Toxicity of Picloram (4-Amino-3,5,6-Trichloropicolinic Acid) to Life Stages of the Rainbow Trout,
W87-08877 5C

HORGAN, C. B. L.
Comparison of Techniques for Evaluating the Effect of Cadmium on Pseudomas Fluorescens,
W87-08648 5C

HORN, S. A.
Atlantic Empress Sinking - A Large Spill Without Environmental Disaster,
W87-09553 5C

HORNE, A. J.
Application of Laboratory Scale Model Streams Toward Assessing Effluent Impacts in Freshwater Lotic Environments,
W87-09314 5C

HORTON, R.
Robust-Resistant Spatial Analysis of Soil Water Infiltration,
W87-09029 7C

HORVATH, I.
Scale-Up and Scale-Down Concepts and Problems,
W87-09432 5D

HOULSBY, G. T.
BASIC Soil Mechanics,
W87-09307 8D

HOUSTON, J. R.
Erosion Control of Scour During Construction; Report 6: FINITE - A Numerical Model for Combined Refraction and Diffraction of Waves,
W87-09482 8B

HOUSTON, L.
Maintenance and Stability of Introduced Genotypes in Groundwater Aquifer Material,
W87-09391 5B

HOWARD, K. W. F.
Comparison of Field and Laboratory Methods for Determining Contaminant Flow Parameters,
W87-08757 5B

HOWARD-WILLIAMS, C.
Photosynthate Distribution by Microplankton in Permanently Ice-Covered Antarctic Desert Lakes,
W87-08872 2H

HOWATT, S. L.
Digestion of Carbohydrates and Protein by Gammarus mucronatus Say (Amphipoda),
W87-08839 2L

HOWE, C. W.
Economic, Legal, and Hydrologic Dimensions of Potential Interstate Water Markets,
W87-09211 6C

HOWELL, T. A.
Traveling Trickle Irrigation System,
W87-09465 3F

HSU, C. L.
Enhanced Uptake of Phosphorus by Activated Sludge - Effect of Substrate Addition,
W87-09270 5D

HUBBARD, R. K.
Transport of Solids in Streamflow from Coastal Plain Watersheds,
W87-08924 2J

HUCK, P. M.
Scale-Up of a Radium-226 Removal Process,
W87-09448 5D

HUDSON, J. A.
Effect of Upland Pasture Improvement on Nutrient Release in Flows from a 'Natural' Lysimeter and a Field Drain,
W87-08741 5G

HUDSON, P. L.
Thermal and Dissolved Oxygen Characteristics of a South Carolina Cooling Reservoir,
W87-08975 2H

HUDSON, R. J. M.
Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants, Part 1,
W87-09462 5B

HUFFMAN, E. W. D.
Analytical Methodology for Elemental Analysis of Humic Substances,
W87-09083 7B

HUGGINS, A. W.
SCPP Meteorological and Statistical Support for Period 1 September 1985, 31 August 1986, Volume I: Interim Progress Report,
W87-09334 2B

HUGHES, P. R.
Effect of Fertilization with Municipal Sludge on the Glutathione, Polyamine, and Cadmium Content of Cole Crops and Associated Loopers (Trichoplusia ni),
W87-08835 5C

HUHMARNIEMI, A.
Whitefish and Vendace Stocks in the Regulated Lake Pyhajarvi, Central Finland,
W87-09052 2H

HUIMIN, L.
Modelling of BOD-DO Dynamics in an Ice-Covered River in Northern China,
W87-09262 5B

HUMPHREY, B.
Oil Spill Cleanup with Dispersants: A Boomed Oil Spill Experiment,
W87-09535 5G

HUMPHREY, N. P.
Innovative State Policies for Aiding Community Water Suppliers,
W87-08951 5F

HUNT, C. S.
Hydrogeology of Underground Coal Mines in Illinois,
W87-09573 2F

HUNTER, J.
Immunological Dietary Analysis of Two Penaeid Shrimp Species from a South Carolina Tidal Creek,
W87-08988 2L

HUNTER, K. A.
Principles and Problems of Modeling Cation Enrichment at Natural Air-Water Interfaces,
W87-09170 5B

HUNTER, P. R.
Bacteriological Quality of Drinks From Vending Machines,
W87-08704 5F

HUTCHENS, C. G.
Digital Controller for Discrete Stage Activation of Automatic Pumping Samplers,
W87-08983 7B

HUTTON, J. T.
Bottled Water: An Alternative Source of Safe Drinking Water,
W87-09118 5F

HUTTON, M.
Quantities of Cadmium, Lead, Mercury and Arsenic Entering the U.K. Environment from Human Activities,
W87-08728 5B

HWANG, H.-M.
Degradation of Aniline and Chloroanilines by Sunlight and Microbes in Estuarine Water,
W87-09271 5B

HYDE, J. F.
Recovery of Water from Atmospheric Air in Arid Climates,
W87-08601 5F

HYLLEBERG, J.
Dispersal-Mediated Coexistence of Mud Snails (Hydrobiidae) in an Estuary,
W87-09422 2L

IBALL, K.
Ten Years of Saltmarsh Monitoring - The Case History of a Southampton Water Saltmarsh and a Changing Refinery Effluent Discharge,
W87-09545 5C

IBREKK, H.
Multiattribute Analysis of the Impact on Society of Phosphorus Abatement Measures,
W87-09013 5G

IMBER, B. E.
Metal-Binding Protein in the Pacific Oyster, Crassostrea gigas: Assessment of the Protein as a Biochemical Environmental Indicator,
W87-08885 5A

IMBODEN, D. M.
Dynamics of Bottom Currents in a Small Lake,
W87-08865 2H

INTROCASO, D. M.
Coolidge Dam: Photographs Written Historical and Descriptive Data Reduced Copies of Drawings,
W87-09163 8A

ISAAC, G. A.
Canadian Atlantic Storms Program: The Meteorological Field Project,
W87-09255 2B

ISHIWATARI, R.
Geochemistry of Humic Substances in Lake Sediments,
W87-09072 2H

ITTEKKOT, V.
Nature of Organic Matter in Rivers with Deep Sea Connections: The Ganges-Brahmaputra and Indus,
W87-08721 2H

IVERSEN, T. M.
Life Cycles of Four Species of Baetis (Ephemeroptera) in Three Danish Streams,
W87-08764 2H

IZUNO, F. T.
Surge Irrigation Management,
W87-08744 3F

JABS, I.
Short-Term Effects of Polynuclear Aromatic Hydrocarbons on Sea-Surface Microlayer Phytoneuston,
W87-09238 5C

JACENKOW, B.
Application of New Chemical Grouts in Strengthening and Sealing of Soils,
W87-09594 8G

JACKIM, E.
Rapid Aquatic Toxicity Assay Using Incorporation of Tritiated-Thymidine into Sea Urchin, Arbacia punctulata, Embryo: Evaluation of Toxicant Exposure Procedures,
W87-08655 5C

JACKSON, G. A.
Sedimentation in Lake Onalaska, Navigation Pool 7, Upper Mississippi River, Since Impoundment,
W87-08969 2J

JACKSON, K.
Erosion and Sediment Control Handbook,
W87-08686 4D

JACKSON, R.
Trihalomethane Formation in Whirlpool Spas,
W87-09276 5B

JACKSON, T. J.
Temporal Observations of Surface Soil Moisture Using A Passive Microwave Sensor,
W87-08781 2G

JACOBSON, J. S.
Effects of Simulated Acidic Mist on Germination of Alternaria solani and Phytophthora infestans in vitro and their Infection Efficiency and Sporulation on Potato,
W87-09414 5C

Influence of Simulated Acidic Rain on Vegetative and Reproductive Tissues of Cucumber (Cucumis sativus L.),
W87-09232 5C

JAIN, R. K.
Maintenance and Stability of Introduced Genotypes in Groundwater Aquifer Material,
W87-09391 5B

JAMES, B. R.
Forest Soil Organic Horizon Acidification: Effects of Temperature, Time, and Solution/Soil Ratio,
W87-09009 2G

JAMIL, K.
Studies on Water Hyacinth as a Biological Filtre for Treating Contaminants from Agricultural Wastes and Industrial Effluents,
W87-08609 5D

JAMIL, M. Z.
Studies on Water Hyacinth as a Biological Filtre for Treating Contaminants from Agricultural Wastes and Industrial Effluents,
W87-08609 5D

JARDIM, W. F.
Role of Cupric Ions in the Generation of Superoxide in Natural Waters,
W87-08716 2K

JAVANDEL, I.
Groundwater Transport: Handbook of Mathematical Models,
W87-09306 5B

JAVITZ, H. A.
Time/Toxicity Relationships in Short-Term Static, Dynamic, and Plug-Flow Bioassays,
W87-08639 5C

JEFFCOAT, H. H.
Computation of Unsteady Flows in the Alabama River,
W87-08980 2E

JEKEL, M. R.
Biological Drinking Water Treatment Systems Involving Ozone,
W87-09144 5F

JELLUM, E. J.
Influence of Soil Characteristics and Environmental Conditions on Seasonal Variations of Water-Soluble Phosphate in Soils,
W87-09257 2G

JENKINS, D.
Relationship Between Bench Scale and Prototype Activated Sludge Systems,
W87-09449 5D

JENNINGS, M. E.
Computation of Unsteady Flows in the Alabama River,
W87-08980 2E

Data Collection and Instrumentation,
W87-09103 7B

JENSEN, H. E.
Spatial Variability of Soil Water and Evapotranspiration,
W87-08815 2G

JENSEN, K. H.
Modelling of Unsaturated Flow in Heterogeneous Soils Part I: Deterministic Simulations of Water Flow in Soil Profiles,
W87-08816 2G

Modelling of Unsaturated Flow in Heterogeneous Soils Part II: Stochastic Simulation of Water Flow Over a Field,
W87-08817 2G

JESSEN, J.
Life Cycles of Four Species of Baetis (Ephemeroptera) in Three Danish Streams,
W87-08764 2H

JOHANSSON, B.
Hydrological Maps: Development of a System for Calculation and Presentation,
W87-08812 7C

JOHANSSON, P.-O.
Estimation of Groundwater Recharge in Sandy Till with Two Different Methods Using Groundwater Level Fluctuations,
W87-08615 2F

JOHNSON, B. H.
Mathematical Study of the Impact on Salinity Intrusion of Deepening the Lower Mississippi River Navigation Channel,
W87-09095 5B

JOHNSON, C. A.
Hydrological and Chemical Factors Controlling the Concentrations of Fe, Cu, Zn and As in a River System Contaminated by Acid Mine Drainage,
W87-09277 5B

JOHNSON, D. E.
Comparison of QSAR Predictions with Fish Toxicity Screening Data for 110 Phenols,
W87-08637 5C

JOHNSON, D. L.
Effect of 'Whiting' on Optical Properties and Turbidity in Owasco Lake, New York,
W87-08966 2H

JOHNSON, E. R.
Conformal-Mapping Technique for Topographic-Wave Problems: Semi-Infinite Channels and Elongated Basins,
W87-09384 7C

JOHNSON, F. A.
Comparison of Backwash Models for Granular Media,
W87-09372 5D

JOHNSON, G. C.
Kinetics of Sulfate Adsorption and Desorption by Cecil Soil Using Miscible Displacement,
W87-08995 2G

JOHNSON, G. V.
Economic Differences Between Cumulative and Episodic Reduction of Sediment from Cropland,
W87-09090 2J

JOHNSON, M. G.
Coherent, Plunging Water Jets for Oil Spill Control,
W87-09565 5G

JOHNSON, R. C.
Leaf Photosynthesis and Conductance of Selected Triticum Species at Different Water Potentials,
W87-09419 2I

JOHNSON, T. C.
Atmospheric Concentrations and Deposition of Polychlorinated Biphenyls to Lake Superior,
W87-09185 5B

JOLLY AND, K. S.
History of the Carlsbad Basin, Southeastern New Mexico,
W87-09151 6G

JONES, D. H.
Catchment Effects on the Horizontal Distribution of Phytoplankton in Five of Scotland's Largest Freshwater Lochs,
W87-08790 2H

JONES, M. M.
Leaching Behaviors of Low-Sulfur Coals and Coal Wastes from Three Western Coal Preparation Plants,
W87-09429 5B

JONES, P. H.
Enhanced Uptake of Phosphorus by Activated Sludge - Effect of Substrate Addition,
W87-09270 5D

JONES, R. I.
Three Day Study of the Diel Behaviour of Plankton in a Highly Humic and Steeply Stratified Lake,
W87-08766 2H

JONES, T. L.
Measurement of Water Potential in Low-Level Waste Management,
W87-09456 7B

JONSSON, B.
Lake Effect on Stream Living Brown Trout (Salmo trutta),
W87-08763 2H

JORGENSEN, N. O. G.
Free Amino Acids in Lakes: Concentrations and Assimilation Rates in Relation to Phytoplankton and Bacterial Production,
W87-08868 2H

JOSHI, O. P.
Influence of Long Term Cultural Operations on Physical and Water Retention Characters of a Red Sandy Loam Soil,
W87-08773 2G

JOSLIN, J. D.
Chemistry of Tension Lysimeter Water and Lateral Flow in Spruce and Hardwood Stands,
W87-08926 5B

JUTILA, E.
Dredging of Rapids for Timber-Floating in Finland and Its Effects on River-Spawning Fish Stocks,
W87-09045 6G

JUTMAN, T.
Hydrological Maps: Development of a System for Calculation and Presentation,
W87-08812 7C

KAATRA, K.
Water Level Regulation of Lake Inari: Impacts and Compensation Measures,
W87-09053 2H

KADANE, J. B.
Scavenging of Atmospheric Sulfate by Arctic Snow,
W87-08947 2C

KAESLER, R. L.
Role of Electrofishing in Assessing Environmental Quality of the Wabash River,
W87-09328 5A

KAFRI, U.
Proposed Hydrogeological Model for Future Lignite Mining and Groundwater Drainage in the Hula Basin, Northern Israel,
W87-09578 2F

KAJIKAWA, T.
Movement of Oligotrophic Bacteria in Activated Sludge,
W87-08771 5D

KAKAREKA, J. P.
Analytical Chemistry,
W87-09295 5B

KALFF, J.
Algal Phagotrophy: Regulating Factors and Importance Relative to Photosynthesis in Dinobryon (Chrysophyceae),
W87-08929 2H

Regulation of Submerged Aquatic Plant Distribution in a Uniform Area of a Weedbed,
W87-08836 2H

KALUARACHCHI, J. J.
Finite Element Analysis of Water Flow in Variably Saturated Soil,
W87-08620 2G

KANA, T. W.
Burmah Agate - Chronology and Containment Operations,
W87-09519 5B

Onshore Impacts and Cleanup During the Burmah Agate Oil Spill - November 1979,
W87-09518 5C

KANE, A. E.
Dolores Archaeological Program: Anasazi Communities at Dolores: Early Anasazi Sites in the Sagehen Flats Area,
W87-09330 6G

KANGAS, J.
Ammonia, Hydrogen Sulphide and Methyl Mercaptides in Finnish Municipal Sewage Plants and Pumping Stations,
W87-08725 5D

KARELIN, V. Y.
Programmed Closing of Gates Upon Loss of Drive by a Pump Unit,
W87-09355 8C

KARICKHOFF, S. W.
Pollutant Sorption in Environmental Systems,
W87-08677 5B

KARLIN, E. F.
Vegetation of the Low-Shrub Bogs of Northern New Jersey and Adjacent New York: Ecosystems at Their Southern Limit,
W87-08715 2H-

KARLIN, R. J.
Committee Report: Microbiological Considerations for Drinking Water Regulation Revisions,
W87-08959 5F

KARLIN, S. I.
On-Site Observations of the State of Structures at the Kanev Lock,
W87-09363 7A

Seepage Regime in the Foundation of the Kanev Hydroelectric Station,
W87-09364 8D

KARLINGER, M. R.
Use of Topological Information in Hydrograph Estimation,
W87-08976 2E

KASAHARA, I.
Spectrophotometric Determination of Traces of Silicon in Water after Collection as Silicomolybdenum Blue on an Organic-Solvent-Soluble Membrane Filter,
W87-08833 5A

KASHEF, A.-A. I.
Groundwater Engineering,
W87-08687 2F

KATTI, S. R.
Lead Nitrate Induced Changes in the Thyroid Physiology of the Catfish Clarias batrachus (L),
W87-08850 5C

KATZ, C. N.
Processes Affecting the Distribution of Low-Molecular-Weight Aliphatic Hydrocarbons in Cook Inlet, Alaska,
W87-09506 5B

KATZ, P.
History of the Carlsbad Basin, Southeastern New Mexico,
W87-09151 6G

Pecos Past: The Prehistory and History of the Brantley Project Locality,
W87-09155 6G

Prehistory of the Carlsbad Basin, Southeastern New Mexico,
W87-09156 6G

KATZ, S. R.
History of the Carlsbad Basin, Southeastern New Mexico,
W87-09151 6G

Pecos Past: The Prehistory and History of the Brantley Project Locality,
W87-09155 6G

Prehistory of the Carlsbad Basin, Southeastern New Mexico,
W87-09156 6G

KAYAMA, M.
Suppression of Phosphate Liberation from Sediment by Using Iron Slag,
W87-09273 5G

KAZACHENKO, A. N.
Concrete Dam of the Denin Dnepr Hydroelectric Station,
W87-09352 8A

KAZAK, R.
Exposure to Legionella in Geriatric Institutions,
W87-08907 5B

KEELY, J. F.
Monitoring Well Installation, Purging, and Sampling Techniques - Part 1: Conceptualizations,
W87-08755 7B

Performance and Analysis of Aquifer Tracer Tests with Implications for Contaminant Transport Modeling - A Project Summary,
W87-08759 5B

KEEN, C. S.
Impact of Mesoscale Convective Systems on Regional Visibility and Oxidant Distributions during Persistent Elevated Pollution Episodes,
W87-08695 2B

KEIRN, M. A.
Impact of Trinitrotoluene Wastewaters on Aquatic Biota in Lake Chickamauga, Tennessee,
W87-09322 5C

Manual of Stream Channelization Impacts on Fish and Wildlife,
W87-09497 6G

KELLY, C. A.
Simultaneous Measurement of Primary Production by Whole-Lake and Bottle Radiocarbon Additions,
W87-08931 2H

KELLY, F. J.
Surveillance, Tracking, and Model Correlation of the Spill from the Tanker Burmah Agate,
W87-09520 7B

KELLY, J. M.
Chemistry of Tension Lysimeter Water and Lateral Flow in Spruce and Hardwood Stands,
W87-08926 5B

KEMBLOWSKI, M.
Impact of the Dupuit-Forchheimer Approximation on Salt-Water Intrusion Simulation,
W87-08758 2F

KENNISH, M. J.
Ecology of Estuaries, Volume I: Physical and Chemical aspects,
W87-09066 2H

KESSERU, Z.
Plans and Experiments to Deal with Large Amounts of Sediment in Hungarian Mines under Karstic Water Hazard,
W87-09590 4C

KEULEGAN, G. H.
Mathematical Study of the Impact on Salinity Intrusion of Deepening the Lower Mississippi River Navigation Channel,
W87-09095 5B

KHAN, H. H.
Influence of Long Term Cultural Operations on Physical and Water Retention Characters of a Red Sandy Loam Soil,
W87-08773 2G

KHANGAROT, B. S.
Correlation between Heavy Metal Acute Toxicity Values in Daphnia magna and Fish,
W87-08887 5A

KHANNA-CHOPRA, R.
Irrigation in India: A Physiological and Phenological Approach to Water Management in Grain Crops,
W87-09468 3F

KHANNA, P.
Methane Recovery from Water Hyacinth Through Whole-Cell Immobilization Technology,
W87-09420 5D

KHANNA, P. K.
Dynamics of Sulfate Retention by Acid Forest Soils in an Acidic Deposition Environment,
W87-09008 5B

KHEBOIAN, C.
Accuracy of Selective Extraction Procedures for Metal Speciation in Model Aquatic Sediments,
W87-08985 5A

KHUDENKO, B. M.
Development of a New Type of Fluidized Bed Reactor,
W87-09444 5D

Geometric Parameters and Efficiency of Diffused Air Systems,
W87-09437 5D

KIBLER, D. F.
Desk-Top Methods for Urban Stormwater Calculation,
W87-09100 2A

KICENIUK, J. W.
Feeding Reduction and Recovery in Cunner Tautogolabrus adspersus Following Exposure to Crude Oil,
W87-09239 5C

KIEFER, R.
Biological Effects of Continuous and Intermittent Dosing of Outdoor Experimental Streams with Chloropyrifos,
W87-08634 5C

KIESSER, S. L.
Toxicity of Chemically Dispersed Oil to Shrimp Exposed to Constant and Decreasing Concentrations in a Flowing System,
W87-09516 5C

KILIAN, E.
Water Vapor Uptake and Photosynthesis of Lichens: Performance Differences in Species with Green and Blue-Green Algae as Phycobionts,
W87-09345 2I

KILLEY, R. W. D.
Comparison of Field and Laboratory Methods for Determining Contaminant Flow Parameters,
W87-08757 5B

KIM, J.
Turbulence Statistics in Fully Developed Channel Flow at Low Reynolds Number,
W87-09383 8B

KIMBALL, K. D.
Two New Ground-Level Cloud Water Sampler Designs Which Reduce Rain Contamination,
W87-08948 7B

KIMMERER, W. J.
Theory of Secondary Production Calculations for Continuously Reproducing Populations,
W87-08862 2L

KINDINGER, M. E.
Effects of the Ixtoc I Oil Spill on the Intertidal and Subtidal Infaunal Populations Along Lower Texas Coast Barrier Island Beaches,
W87-09556 5C

KING, D. A.
Model for Predicting the Influence of Moisture Stress on Crop Losses Caused by Ozone,
W87-08783 2I

KING, J. M.
Toxicity of Aqueous Extracts of Natural and Synthetic Oils to Three Species of Lemna,
W87-08647 5C

KING, J. N.
Determination of Cobalt, Copper, Mercury, and Nickel as Bis(2-hydroxyethyl)dithiocarbamate Complexes by High-Performance Liquid Chromatography,
W87-08831 5A

KING, L. D.
Swine Lagoon Effluent Applied to Coastal Bermudagrass,
W87-09472 5D

Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: I. Persistence, Yield, Quality, and Elemental Removal,
W87-08919 5C

Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: II. Rainfall Runoff and Soil Chemical Properties,
W87-08920 5C

KIRBY, L. J.
Trees as Indicators of Subterranean Water Flow from a Retired Radioactive Waste Disposal Site,
W87-08845 5A

KIRKHAM, R. R.
Measurement of Water Potential in Low-Level Waste Management,
W87-09456 7B

KISTLER, D.
Vertical Transport of Heavy Metals by Settling Particles in Lake Zurich,
W87-08869 5B

KITANIDIS, P. K.
Error Analysis of Conventional Discrete and Gradient Dynamic Programming,
W87-09023 7C

KIUREGHIAN, A. D.
First-Order Reliability Approach to Stochastic Analysis of Subsurface Flow and Contaminant Transport,
W87-09017 5B

KJARAN, S. P.
Geothermal Reservoir Engineering Experience in Iceland,
W87-08830 6G

KLECKA, G. M.
Biodegradation,
W87-08680 5B

KLING, C. L.
Estimating the Value of Water Quality Improvements in a Recreational Demand Framework,
W87-09033 6C

KLING, G. W.
1986 Lake Nyos Gas Disaster in Cameroon, West Africa,
W87-08780 2H

KLOPFER, D. C.
Usefulness of the Lipid Index for Bioaccumulation Studies with Daphnia magna,
W87-08652 5C

KNEIB, R. T.
Predation Risk and Use of Intertidal Habitats by Young Fishes and Shrimp,
W87-08787 2L

KNEZOVICH, J. P.
New Method for Determining the Concentrations of Volatile Organic Compounds in Sediment Interstitial Water,
W87-09233 5A

KNOX, R. C.
Ground Water Pollution Control,
W87-09150 5G

Septic Tank System Effects on Ground Water Quality,
W87-09310 5C

KNUDSEN, J.
WATBAL: A Semi-Distributed, Physically Based Hydrological Modelling System,
W87-08823 2G

KOBAKHIDZE, V. D.
Arch Dam of the Khudoni Hydroelectric Station,
W87-09353 8A

KOBATA, T.
Changes at Panicle Emergence in the Water Relations of a Wetland and a Dryland Japonica Rice Cultivar Under Wetland Conditions,
W87-09415 2I

KOBATAKE, N.
Chemical Changes of Organic Compounds in Chlorinated Water: XII. Gas Chromatographic-Mass Spectrometric Studies of the Reactions of Methylnaphthalenes with Hypochlorite in Dilute Aqueous Solution,
W87-09224 2K

KOCSANYI, L.
Plans and Experiments to Deal with Large Amounts of Sediment in Hungarian Mines under Karstic Water Hazard,
W87-09590 4C

KOEHL, M. A. R.
Scanning Currents in Stokes Flow and the Efficient Feeding of Small Organisms,
W87-09385 2H

KOLESNIKOV, V. I.
Measures to Reduce the Level of Vibrations of Turbine-Generator Units,
W87-09365 8C

KONISHI, Y.
Separation of Mercury from Aqueous Mercuric Chloride Solutions by Onion Skins,
W87-08606 5D

KOOIJMAN, S. A. L. M.
Safety Factor for LC50 Values Allowing for Differences in Sensitivity Among Species,
W87-09266 5C

KOORNHOF, H. J.
Seasonality of Legionella Isolates from Environmental Sources,
W87-08902 2H

KOPOTEVA, T. A.
Production-Destruction Processes in Ecosystems of Grassy Marshes of the Amur River Region,
W87-08709 2H

KOPTEV, V. I.
Detection of Defects in a Grout Curtain by Geophysical Methods,
W87-09358 8E

KOR, S.
Toxicity of Ballast-Water Treatment Effluent to Marine Organisms at Port Valdez, Alaska,
W87-09514 5C

KORFMACHER, W. A.
Use of Bullfrogs (Rana catesbeiana) as Biological Markers for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin Contamination in the Environment,
W87-08733 5A

KORIDZE, G. I.
Arch Dam of the Khudoni Hydroelectric Station,
W87-09353 8A

KORSCHGEN, C. E.
Sedimentation in Lake Onalaska, Navigation Pool 7, Upper Mississippi River, Since Impoundment,
W87-08969 2J

KOSOWATZ, J. J.
Giant Water Tank Rises in Austin,
W87-08801 5F

KOVACS, Z.
Extreme Floods in Southern Africa Caused by Tropical Cyclone Domoina,
W87-09410 2F

KOVALAK, W. P.
Assessment and Prediction of Impacts of Effluents on Communities of Benthic Stream Macroinvertebrates,
W87-09324 5C

KOZA, J.
Some Hydrogeological Solutions to the Exploitation of Underground Lignite Mines (Quelques Solutions Hydrogeologiques dans la Construction des Mines de Lignite Souterraines),
W87-09597 4B

KOZLOWSKI, T. T.
Effects of Flooding, Tilting of Stems, and Ethrel Application on Growth, Stem Anatomy and Ethylene Production of Pinus Densiflora Seedlings,
W87-08797 2I

KRAJEWSKI, W. F.
Radar Rainfall Data Quality Control by the Influence Function Method,
W87-09022 7C

KRAMER, J. R.
Acid Neutralizing Capacity of Fine Soil Fractions,
W87-09180 2G

KRANCE, M.
Counting the Days Along Lake Michigan,
W87-08804 2J

KRAUSMAN, P. R.
Preventing Desert Mule Deer Drownings in the Mohawk Canal, Arizona,
W87-09152 6G

KREBS, C. T.
Restoration of Oiled Marshes Through Sediment Stripping and Spartina Propagation,
W87-09546 5G

KROG, C.
Physical Structure and Brown Trout (Salmo trutta fario) Populations in Small Danish Lowland Streams,
W87-09059 2H

Review of Brown Trout (Salmo trutta) Spawning Beds, Indicating Methods for their Re-establishment in Danish Lowland Rivers,
W87-09047 2H

KROISS, H.
Role of Kinetic Models for the Scale-Up of Biological Processes,
W87-09450 5D

KRSTANOVIC, P. F.
Stochastic Model for Sediment Yield Using the Principle of Maximum Entropy,
W87-09016 2J

KUBIAK, T. J.
Embryotoxicity, Teratogenicity, and Aryl Hydrocarbon Hydroxylase Activity in Forster's Terns on Green Bay, Lake Michigan,
W87-08841 5C

KUCHEN, A.
Quantification of PCB by Dechlorination to Biphenyl,
W87-09259 5A

KUCHTA, J. M.
Survival and Multiplication of Legionella pneumophila in Municipal Drinking Water Systems,
W87-09389 5F

KUCIAUSKAS, A. P.
SCPP Meteorological and Statistical Support for Period 1 September 1985, 31 August 1986, Volume I: Interim Progress Report,
W87-09334 2B

KULIKOV, N. V.
90Sr and 137Cs in Peat Deposits of Low-Lying Bog in the Influence Zone of the Beloyarsk Atomic Power Station,
W87-08710 5B

KUMAR, A.
Recovery of Organics from Tailings Pond Sludge Using Coke for Agglomeration,
W87-08602 5D

KUMAR, S.
Removal of Phenols by Adsorption on Fly Ash,
W87-09250 5D

KUO, S.
Influence of Soil Characteristics and Environmental Conditions on Seasonal Variations of Water-Soluble Phosphate in Soils,
W87-09257 2G

KURIHARA, Y.
Distribution and Abundance of Helice tridens (De Haan) Burrows and Substratum Conditions in a Northeastern Japan Salt Marsh (Crustacea: Brachyura),
W87-08987 2L

KURTZ, J.
Analysis of the Impact of the Sudbury Smelters on Wet and Dry Deposition in Ontario,
W87-08942 5B

KUWABARA, J. S.
Trace Metals,
W87-09292 5C

KYLE, D. E.
Seasonal Distribution of Thermotolerant Free-Living Amoebae. II. Lake Issaqueena,
W87-09225 2H

KYNARD, B.
Spring and Summer Movements of Subadult Striped Bass, Morone saxatilis, in the Connecticut River,
W87-09253 2H

LACERDA, L. D.
Geochemical Partitioning of Heavy Metals in Sediments of Three Estuaries Along the Coast of Rio de Janeiro (Brazil),
W87-08717 2L

LAL, B.
Impact of Pesticides on Lipid Metabolism in the Freshwater Catfish, Clarias batrachus, during the Vitellogenic Phase of Its Annual Reproductive Cycle,
W87-08851 5C

LAL, D.
In Situ Cosmogenic 3H, 14C, and 10Be for Determining the Net Accumulation and Ablation Rates of Ice Sheets,
W87-09249 2C

LAMAR, P. A.
Two New Ground-Level Cloud Water Sampler Designs Which Reduce Rain Contamination,
W87-08948 7B

LAMB, D.
SO2 Oxidation in Cloud Drops Containing NaCl or Sea Salt as Condensation Nuclei,
W87-08950 6E

LAMOREAUX, W.
Effectiveness of Offshore Produced Water Treatment,
W87-09515 5D

LANDERS, R. W.
Effect of Crude Oil on Microbial Processes in Marine Sediments,
W87-09567 5C

LANGE, O. L.
Water Vapor Uptake and Photosynthesis of Lichens: Performance Differences in Species with Green and Blue-Green Algae as Phycobionts,
W87-09345 2I

LARA, M. A. G.
Aerial Application of Dispersants at the Ixtoc I Spill,
W87-09534 5G

LAROSA, P. C.
Hormonal Regulation of Protein Synthesis Associated With Salt Tolerance in Plant Cells,
W87-09227 2I

LARSON, R. A.
Formation of Toxaphene-Like Contaminants During Simulated Paper Pulp Bleaching,
W87-09093 5B

LARSSON, A.
Long-Term Effects of Bleached Kraft Mill Effluents on Carbohydrate Metabolism and Hepatic Xenobiotic Biotransformation Enzymes in Fish,
W87-08854 5C

LARSSON, P.
Attempt to Measure the Flow of Chlorinated Hydrocarbons, such as PCBs, from Water to Air in the Field,
W87-09246 7B

LARSSON, R.
Lateral Mixing in Channels Due to Secondary Currents,
W87-08827 2E

LAUGHLIN, J. K.
Study of Saline Water Use at the Harry Allen Generating Station,
W87-09332 3C

LAURIE, R. D.
Carcinogenic Effects in A/J Mice of Particulate of a Coal Tar Paint Used in Potable Water Systems,
W87-08613 5C

LAVIN, P. T.
Statistical Analysis,
W87-09284 5C

LECH, J. J.
Biotransformation,
W87-09297 5B

LECHEVALLIER, M. W.
Operational Variables and the Release of Colonized Granular Activated Carbon Particles in Drinking Water,
W87-08957 5F

LECKIE, J. O.
Copper in Marine Microlayers: Accumulation, Speciation and Transport,
W87-09172 5B

LEE, C.
Carbon Isotope Fractionation and Changes in the Flux and Composition of Particulate Matter Resulting from Biological Activity during a Sediment Trap Experiment in Lake Greifen, Switzerland,
W87-08867 2H

LEE, C. M.
Scientific Considerations in the International Arena,
W87-08626 6E

LEE, C. R.
Field Survey of Heavy Metal Uptake by Naturally Occurring Saltwater and Freshwater Marsh Plants,
W87-09490 5B

LEE, J. A.
Fate of Some Components of Acidic Deposition in Ombrotrophic Mires,
W87-09382 5B

LEE, M.
Use of Dispersants on Viscous Fuel Oils and Water in Crude Oil Emulsions,
W87-09511 5G

LEE, R. F.
Degradation of Aniline and Chloroanilines by Sunlight and Microbes in Estuarine Water,
W87-09271 5B

Polycyclic Aromatic Hydrocarbons in Oysters (Crassostrea Virginica) from Georgia Coastal Waters, Analyzed by High-Pressure Liquid Chromatography,
W87-09542 5A

LEE, S. E.
Relationship Between Bench Scale and Prototype Activated Sludge Systems,
W87-09449 5D

LEE, T. F.
SCPP Meteorological and Statistical Support for Period 1 September 1985, 31 August 1986, Volume I: Interim Progress Report,
W87-09334 2B

LEEK, W. R.
1979 Southern California Dispersant Treated Research Oil Spills,
W87-09536 5G

LEENHEER, J. A.
Fractionation Techniques for Aquatic Humic Substances,
W87-09082 7B

LEGERON, J.-P.
Ozone Disinfection of Drinking Water,
W87-09135 5F

LEHR, W. J.
Spreading, Dispersion, and Evaporation of Oil Slicks in the Arabian Gulf,
W87-09522 5B

LEHSAU, D.
Polycyclic Aromatic Hydrocarbons in Oysters (Crassostrea Virginica) from Georgia Coastal Waters, Analyzed by High-Pressure Liquid Chromatography,
W87-09542 5A

LELAND, H. V.
Trace Metals,
W87-09292 5C

LEMMIN, U.
Dynamics of Bottom Currents in a Small Lake,
W87-08865 2H

Structure and Dynamics of Internal Waves in Baldeggersee,
W87-08864 2H

LESLEY, S. J.
Establishing Smooth Cordgrass in Tidal Wetlands,
W87-08806 2I

LETTENMAIER, D. P.
Markov Renewal Model for Rainfall Occurrences,
W87-09025 7C

LETTINGA, G.
Methanogenic Toxicity and Anaerobic Degradability of a Hydrolyzable Tannin,
W87-09278 5D

LEUNG, H. K. N.
Subglacial Drainage for an Ice Sheet Resting Upon a Layered Deformable Bed,
W87-09248 2F

LEVANON, D.
Effect of Sewage Sludge on Soil Structural Stability: Microbiological Aspects,
W87-08997 5C

LEVESQUE, M. P.
Downward Movement of Partly Degraded Materials in Dyked Marsh Soils,
W87-08998 2H

LEVINE, A. D.
Curbing THMs in Small Water Systems,
W87-08954 5F

LEVY, R. S.
Prehistoric Cultural Resources Study Predictive Model and Field Survey Weber Basin Project,
W87-09335 6G

LI, D.-H.
Stroboscopic Determination of Settling Velocity, Size and Porosity of Activated Sludge Flocs,
W87-09263 7B

LI, Y.
Absence of Mutagenic and Antimutagenic Activities of Fluoride in Ames Salmonella Assays,
W87-09405 5C

LICHTE, H. W.
Open Ocean Skimmer Performance Tests,
W87-09562 5G

LIGHT, R. W.
Vulnerability of Selected Lakes and Streams in the Middle Atlantic Region to Acidification: A Regional Survey,
W87-09476 5B

LIKENS, G. E.
Decrease in Precipitation Acidity Resulting From Decreased S04(2-) Concentration,
W87-09348 5B

LILJEDAHL, L. A.
Pesticides in Fog,
W87-09229 5B

LILL, G.
Complete HF Digestion Method for Element and Trace Element Determination in Soils, Sediments, Sludges and Other Similar Samples Using a Closed System (HF-Totalaufschluss im geschlossenen System fur Element- und Spurenelementbestimmungen in Boden, Klarschlamm, Sedimenten u. a. Proben),
W87-08894 5A

LIN, C.
Modeling the Flow of Immiscible Fluids in Soils,
W87-09258 2G

LIND, L. B.
Curbing THMs in Small Water Systems,
W87-08954 5F

LINDBERG, S.
Effects of Cd(2+) and EDTA on Young Sugar Beets (Beta vulgaris). II. Net Uptake and Distribution of Mg(2+), Ca(2+), and Fe(2+)/Fe(3+),
W87-09228 2I

LINDBLOM, G. P.
Aerial Application of Dispersants at the Ixtoc I Spill,
W87-09534 5G

LINDSAY, S. A.
Toxicity of Ballast-Water Treatment Effluent to Marine Organisms at Port Valdez, Alaska,
W87-09514 5C

LINDSTROM, G.
Modelling Water Exchange and Transit Times in Till Basins Using Oxygen-18,
W87-08821 2A

LINFIELD, R. S. J.
Effect of Habitat Modification on Freshwater Fisheries in Lowland Areas of Eastern England,
W87-09050 2H

LION, L. W.
Comparison of Toxicity Tests Conducted in the Laboratory and in Experimental Ponds using Cadmium and the Fathead Minnow (Pimephales promelas),
W87-09272 5C

Copper in Marine Microlayers: Accumulation, Speciation and Transport,
W87-09172 5B

LIPNICK, R. L.
Comparison of QSAR Predictions with Fish Toxicity Screening Data for 110 Phenols,
W87-08637 5C

Research Needs in Developing Structure Activity Relationships,
W87-08633 5C

LIPOVICH, M. J.
Survival and Multiplication of Legionella pneumophila in Municipal Drinking Water Systems,
W87-09389 5F

LISS, P. S.
Principles and Problems of Modeling Cation Enrichment at Natural Air-Water Interfaces,
W87-09170 5B

LITTLE, D.
Fate and Effects of Dispersant-Treated Compared with Untreated Crude Oil, with Particular Reference to Sheltered Intertidal Sediments,
W87-09537 5G

LIU, D. H. W.
Time/Toxicity Relationships in Short-Term Static, Dynamic, and Plug-Flow Bioassays,
W87-08639 5C

LIU, J. K.
Quantitative and Qualitative Aspects of Fish Crop in Relation to Environmental Quality,
W87-08855 5C

LLAMAS MADURGA, M. R.
Preliminary Hydrogeological Study of the Reocin Mine (Santander, Spain) (Estudio Hidrogeologico Preliminar de la Mina de Reocin (Santander, Espana)),
W87-09579 2F

LOEFFELMAN, P. H.
New Approach for Regulating Iron in Water Quality Standards,
W87-08636 5G

LOMBARDO, V. N.
Considertion of the Stress-Strain State in Calculations of Slope Stability of Earth Dams,
W87-09356 8D

LOMEN, D. O.
Determination of Hydraulic Conductivity from Auger Holes and Pits - An Approximation,
W87-08617 2F

LONG, B. F. N.
Geomorphological Alteration of a Heavily Oiled Saltmarsh (Ile Grande, France) as a Result of Massive Cleanup,
W87-09543 5B

LONGABUCCO, P.
Impact of Oil on Marsh Communities in the St. Lawrence River,
W87-09541 5C

LOOMIS, D. P.
Relationship Between Water-System Size and 222Rn Concentration in North Carolina Public Water Supplies,
W87-09218 5F

LOPEZ VERA, C. F.
Origin and Dynamics of the Waters Flowing into the Mining Works in Reocin (Santander, Spain) (Sobre el Origen y Dinamica de las Aguas Fluyentes a las Explotaciones Mineras de Reocin (Santander, Espana)),
W87-09586 2F

Preliminary Hydrogeological Study of the Reocin Mine (Santander, Spain) (Estudio Hidrogeologico Preliminar de la Mina de Reocin (Santander, Espana)),
W87-09579 2F

LORES, E. M.
Field Confirmation of a Laboratory-Derived Hazard Assessment of the Acute Toxicity of Fenthion to Pink Shrimp, Penaeus duorarum,
W87-08638 5C

LOUCKS, D. P.
Interactive Computer-Aided Water Resources and Environmental Planning Using Color Raster Graphics: Program Description and User's Guide,
W87-09426 7C

LUFT, P.
Prediction of Fixed-Bed Adsorber Removal of Organics in Unknown Mixtures,
W87-09369 5D

LUNDGREN, B. V.
Removal of Individual Off-Flavour Compounds in Water During Artificial Groundwater Recharge and During Treatment by Alum Coagulation/Sand Filtration,
W87-09267 5F

Systematic Approach to Adsorption on XAD-2 Resin for the Concentration and Analysis of Trace Organics in Water Below the (mu)g/l Level,
W87-09011 5A

LUSIS, M. A.
Analysis of the Impact of the Sudbury Smelters on Wet and Dry Deposition in Ontario,
W87-08942 5B

LUTTGE, U.
Effects of Water Stress on Gas Exchange and Water Relations of Succulent Epiphyte, Kalanchoe Uniflora,
W87-09347 2I

LYMAN, W. J.
Estimation of Physical Properties,
W87-08676 5B

LYNCH, B.
Use of Dispersants on Viscous Fuel Oils and Water in Crude Oil Emulsions,
W87-09511 5G

LYNN, L. M.
Vegetation of the Low-Shrub Bogs of Northern New Jersey and Adjacent New York: Ecosystems at Their Southern Limit,
W87-08715 2H

LYONS, W. A.
Impact of Mesoscale Convective Systems on Regional Visibility and Oxidant Distributions during Persistent Elevated Pollution Episodes,
W87-08695 2B

LYONS, W. B.
Seasonal and Spatial Trends in South Greenland Snow Chemistry,
W87-08946 5B

LYSYJ, I.
Distribution of Aromatic Hydrocarbons in Port Valdez, Alaska,
W87-09513 5B

Effectiveness of Offshore Produced Water Treatment,
W87-09515 5D

MAAS, C.
Unsteady Flow to Wells in Layered and Fissured Aquifer Systems,
W87-08618 2F

MABEY, W.
Photochemical Transformations,
W87-08682 5B

MACCARTHY, P.
Spectroscopic Methods (Other Than NMR) for Determining Functionality in Humic Substances,
W87-09087 7B

MACDONALD, R. W.
Biodegration of Chemically Dispersed Crude Oil,
W87-09512 5B

MACEK, K. J.
Effluent Evaluation,
W87-09302 5A

MACIEL, G. E.
Geochemistry of Humin,
W87-09077 2H

MACKAY, D.
Air/Water Exchange Coefficients,
W87-08679 5B

Laboratory Determination of Dispersant Effectiveness: Method Development and Results,
W87-09509 5G

Transfer Rates of Gaseous Pollutants Between the Atmosphere and Natural Waters,
W87-09167 5B

MACKIN, J. E.
Organic Matter and Heavy Metal Concentrations in the Particulate Phase of Lake Michigan Surface Microlayers,
W87-09171 5B

MACROMINI, A.
Simultaneous Determination of Linear Alkylbenzenesulfonates, Alkylphenol Polyethoxylates, and Nonylphenol by High-Performance Liquid Chromatography,
W87-09343 5A

MADARIAGA, B.
Exploring Existence Value,
W87-09031 6C

MADDEN, M.
Polycyclic Aromatic Hydrocarbons in Oysters (Crassostrea Virginica) from Georgia Coastal Waters, Analyzed by High-Pressure Liquid Chromatography,
W87-09542 5A

MADHAVENDRA, S. S.
Studies on Water Hyacinth as a Biological Filtre for Treating Contaminants from Agricultural Wastes and Industrial Effluents,
W87-08609 5D

MADSEN, H.
Correction of Liquid Precipitation,
W87-08813 2B

MAGRATH, P. A. G.
Ameliorative Methods to Reinstate Fisheries Following Land Drainage Operations,
W87-09048 6G

MAHAFFEY, W. R.
Biodegradation of Trichloroethylene and Involvement of an Aromatic Biodegradative Pathway,
W87-09387 5D

MAIER, D.
Microflocculation by Ozone,
W87-09142 5F

MAIERO, D. J.
Mapping the Distribution of Protected and Valuable, Oil-Sensitive Coastal Fish and Wildlife,
W87-09540 7A

MAJID, A.
Recovery of Organics from Tailings Pond Sludge Using Coke for Agglomeration,
W87-08602 5D

MAKI, A. W.
Chemical Safety Evaluation,
W87-09301 5B

MAKOVSKII, V. I.
90Sr and 137Cs in Peat Deposits of Low-Lying Bog in the Influence Zone of the Beloyarsk Atomic Power Station,
W87-08710 5B

MALAFANT, K. W. J.
Analysis of Volume Change in Unconfined Units of Soil,
W87-08992 2G

MALCOLM, R. L.
Geochemistry of Stream Fulvic and Humic Substances,
W87-09073 2H

MALM, O.
Heavy Metal Pollution in the Paraiba do Sul River, Brazil,
W87-08718 5B

MALMQVIST, B.
Influence of Substrate Stability on the Composition of Stream Benthos: An Experimental Study,
W87-09403 2H

MALYSHGEV, B. N.
Assignment of Strength Requirments of Concrete for Large Dams,
W87-09354 8F

MANNINEN, A.
Ammonia, Hydrogen Sulphide and Methyl Mercaptides in Finnish Municipal Sewage Plants and Pumping Stations,
W87-08725 5D

MANWARING, J. F.
Public Drinking Water and Chemicals,
W87-09117 5C

MAREK, B.
Quantification of PCB by Dechlorination to Biphenyl,
W87-09259 5A

MARENGO, G.
Correlation of a Lake Eutrophication Model to Field Experiments,
W87-08900 2H

MARES, S.
Application of Isotope Techniques and Well Loggind in Investigating Ground Water Influenced by Mining,
W87-09580 2F

MARET, T. J.
Effect of Beaver Ponds on the Nonpoint Source Water Quality of a Stream in Southwestern Wyoming,
W87-09265 2H

MARGAT, J.
Groundwater Management in France,
W87-09205 2F

MARGOLIS, L.
Comparison of Parasite Fauna of Juvenile Sockeye Salmon (Oncorhynchus Nerka) from Southern British Columbian and Washington State Lakes,
W87-08792 2H

MARINOS, G. P.
Problems of Water Inrush into Greek Underground Mines with Special Emphasis to Sea Water Inrush Through Karstic Limestones or Impermeable Formations,
W87-09596 2F

MARINOS, P. G.
System of Underground Water in a Karstic Country and the Tunnels Excavated for Water Transport to Athens (le Regime des Eaux Souterraines dans un Pays Karstique et les Galeries de la Grande Adduction d'Eau d'Athenes),
W87-09595 2F

MARKING, L. L.
Toxicity of Chemical Mixtures,
W87-09286 5C

MARKLE, D. G.
Kahului Breakwater Stability Study, Kahului, Maui, Hawaii: Hydraulic Model Investigation,
W87-09488 8B

MARLEY, K. A.
Formation of Toxaphene-Like Contaminants During Simulated Paper Pulp Bleaching,
W87-09093 5B

MARSH, F. L.
Institutional Analysis in Community Decision-Making: A Case Example from Southern Arizona,
W87-08981 6A

MARSH, G.
Simplified Models to Predict the Breakup of Oil on Rough Seas,
W87-09521 5B

MARSH, W.
Polycyclic Aromatic Hydrocarbons in Oysters (Crassostrea Virginica) from Georgia Coastal Waters, Analyzed by High-Pressure Liquid Chromatography,
W87-09542 5A

MARTINELLI, L. A.
Role of Gas Exchange in the Inorganic Carbon, Oxygen, and 222Rn Budgets of the Amazon River,
W87-08871 2H

MARTINEZ, E. X.
Fish Predation on Juvenile Brown Shrimp, Penaeus Aztecus Ives: Effects of Turbidity and Substratum on Predation Rates,
W87-09252 2H

MARUOKA, S.
Isolation of Mutagenic Components by High-Performance Liquid Chromatography from XAD Extract of Water from the Nishitakase River, Kyoto City, Japan,
W87-08723 5A

MASCARENHAS, J. M.
Roman Dams in Southern Portugal,
W87-09411 6E

MASIRONI, R.
Geochemistry, Soils and Cardiovascular Diseases,
W87-08692 2F

MATHUR, S. P.
Downward Movement of Partly Degraded Materials in Dyked Marsh Soils,
W87-08998 2H

Geochemistry of Humic Substances in Natural and Cultivated Peatlands,
W87-09069 2H

MATINELLI, F.
Use of Dispersants on Viscous Fuel Oils and Water in Crude Oil Emulsions,
W87-09511 5G

MATTER, R. M.
Manual of Stream Channelization Impacts on Fish and Wildlife,
W87-09497 6G

MATTHIAS, A. D.
Bare Soil Evaporation Near a Surface Point-Source Emitter,
W87-08743 2D

MATURA, M.
Some Hydrogeological Solutions to the Exploitation of Underground Lignite Mines (Quelques Solutions Hydrogeologiques dans la Construction des Mines de Lignite Souterraines),
W87-09597 4B

MATZKANIN, G. A.
Pulsed Nuclear Magnetic Resonance Instrument for Soil-Water Content Measurement: Sensor Configurations,
W87-08991 7B

MATZNER, E.
Dynamics of Sulfate Retention by Acid Forest Soils in an Acidic Deposition Environment,
W87-09008 5B

MAYER, F. L.
Biochemistry/Physiology,
W87-09289 5C

MAYER, L. M.
Geochemistry of Humic Substances in Estuarine Environments,
W87-09074 2H

MAYER, T.
Use of Bog Vegetation as a Monitor of Atmospheric Input of Metals,
W87-09182 5C

MAYES, M. A.
Aquatic Hazard Assessment: Picloram,
W87-08643 5C

Toxicity of Picloram (4-Amino-3,5,6-Trichloropicolinic Acid) to Life Stages of the Rainbow Trout,
W87-08877 5C

MAYEWSKI, P. A.
Scavenging of Atmospheric Sulfate by Arctic Snow,
W87-08947 2C

Seasonal and Spatial Trends in South Greenland Snow Chemistry,
W87-08946 5B

MAYNORD, S. T.
Design of Spillway Crests,
W87-09195 8A

MAYO, J. A.
Growth of Mixed Microbial Populations in Ground Water Containing Highly Chlorinated Organic Wastes,
W87-08878 5B

MAYS, P. A.
Chemistry of Tension Lysimeter Water and Lateral Flow in Spruce and Hardwood Stands,
W87-08926 5B

MCALICE, B. J.
Seasonality of Blue Mussel, Mytilus edulis L., Larvae in the Damariscotta River Estuary, Maine, 1969-77,
W87-08849 2L

MCANNALLY, W. H.
Spectral Analysis of Columbia River Estuary Currents,
W87-09430 2L

MCAULIFFE, C. D.
1979 Southern California Dispersant Treated Research Oil Spills,
W87-09536 5G

MCCARTHY, D. T.
Adverse Effects of Channelization and Their Amelioration,
W87-09043 6G

MCCARTHY, K. J.
Determination of Low Levels of Cationic Polyelectrolytes in Water,
W87-08986 5A

MCCARTHY, L. T.
Evaluation of Oil Spill Dispersant Testing Requirements,
W87-09508 5G

MCCARTNEY, A. C.
Outbreak of Legionnaires' Disease in Glasgow Royal Infirmary: Microbiological Aspects,
W87-08703 5C

MCCATCHEON, S.
Laboratory and Instream Nitrification Rates for Selected Streams,
W87-09378 2H

MCCAULEY, C. A.
Effects of Oil Spill Cleanup Techniques on a Salt Marsh,
W87-09548 5C

MCCLAVE, J. T.
Statistical Techniques for Evaluating Procedures and Results for Periphyton Sampling,
W87-09319 7C

MCCLELLAND, N. I.
Effective Alternative to Official Regulation of Indirect Additives to Drinking Water,
W87-09120 5F

MCCLUNG, J. E.
Predicting Settlement at a Damsite on a Tunnel Valley Deposit in Alberta,
W87-08795 8A

MCCONAGHY, D. C.
Focus: Fisheries Oceanography Cooperative Users System,
W87-09500 7C

MCCONNELL, K. E.
Exploring Existence Value,
W87-09031 6C

MCCORD, S.
History of the Carlsbad Basin, Southeastern New Mexico,
W87-09151 6G

MCCOY, P.
Transport and Dry Deposition of Trace Metals over Southern Lake Michigan,
W87-09179 5B

MCCULLOCH, W. L.
Impact of the Esso Bayway Oil Spill on Salt Marsh Macro Fauna,
W87-09550 5C

MCDANIELS, A. E.
Comparison of the Hydrophobic-Grid Membrane Filter Procedure and Standard Methods for Coliform Analysis of Water,
W87-09392 5A

MCFADDEN, E.
Chromatographic Studies of Dissolved Organic Matter and Copper-Organic Complexes Isolated From Estuarine Waters,
W87-08960 7B

MCFARLAND, B. H.
Effects of Copper on the Periphyton of a Small Calcareous Stream,
W87-09318 5C

Effects of Exposure Time, Season, Substrate Type, and Planktonic Populations on the Taxonomic Composition of Algal Periphyton on Artificial Substrates in the Ohio and Little Miami Rivers, Ohio,
W87-09321 5C

MCFARLAND, M.
Lake Loading Ratios (N:P) and Lacustrine Nitrogen Fixation,
W87-08972 2H

MCFETERS, G. A.
Operational Variables and the Release of Colonized Granular Activated Carbon Particles in Drinking Water,
W87-08957 5F

MCGARRY, D.
Analysis of Volume Change in Unconfined Units of Soil,
W87-08992 2G

MCGRATH, C. J.
Role of the Fisheries Engineer in the Design and Execution of Arterial Drainage Schemes,
W87-09044 8I

MCGRATH, S. P.
Zinc, Copper and Nickel Concentrations in Soil Extracts and Crops Grown on Four Soils Treated with Metal-loaded Sewage Sludges,
W87-09244 5B

MCKAY, G.
Desorption and Regeneration of Dye Colours from Low-Cost Materials,
W87-09279 5D

MCKENZIE, J. A.
Carbon Isotope Fractionation and Changes in the Flux and Composition of Particulate Matter Resulting from Biological Activity during a Sediment Trap Experiment in Lake Greifen, Switzerland,
W87-08867 2H

MCKIM, J. M.
Early Life Stage Toxicity Tests,
W87-09282 5C

MCKNIGHT, D. M.
Evaluation of Natural Tracers in an Acidic and Metal-Rich Stream,
W87-09021 7B

MCLAREN, J. W.
Determination of Trace Metals in a River Water Reference Material by Inductively Coupled Plasma Mass Spectrometry,
W87-08832 5A

MCLAUGHLIN, R. D.
Instrumentation for Environmental Monitoring, Volume 2: Water,
W87-09303 5A

MCNAUGHT, D. C.
Appropriate Durations and Measures for Ceriodaphnia Toxicity Tests,
W87-08654 5C

MCPHAIL, M. J.
Focus: Fisheries Oceanography Cooperative Users System,
W87-09500 7C

MEAD, S. W.
Water-Quality Monitoring at the Hoe Creek Test Site: Review and Preliminary Conclusions,
W87-09495 5B

MEANS, J. C.
Microbially Mediated Leaching of Low-Sulfur Coal in Experimental Coal Columns,
W87-09393 5B

MEASURES, C. I.
Selenium in the Tributaries of the Orinoco in Venezuela,
W87-09406 2K

MEEKS, D. G.
View of the Laboratory Testing and Assessment of Oil Spill Dispersant Efficiency,
W87-09510 5G

MEHANNI, A. H.
Perennial Pasture Production after Irrigation with Saline Groundwater in the Goulburn Valley, Victoria,
W87-09208 3C

MEHLS, S. F.
Archaeological and Historical Surveys of Selected Portions of the Umatilla Basin Project, Umatilla County, Oregon,
W87-09425 6G

MEHRAN, M.
Distribution Coefficient of Trichloroethylene in Soil-Water Systems,
W87-08752 5B

MEHRLE, P. M.
Biochemistry/Physiology,
W87-09289 5C

MEHTA, C. R.
Statistical Analysis,
W87-09284 5C

MEIKLE, K. M.
Oil Slick Igniter for remote Areas,
W87-09559 5G

MEIWES, K. J.
Dynamics of Sulfate Retention by Acid Forest Soils in an Acidic Deposition Environment,
W87-09008 5B

MELLIORIS, L.
Influence of Underground Engineering Works on Hydrogeological Conditions of the Suburban Areas,
W87-09581 2F

MELVILLE, J. G.
Performance and Analysis of Aquifer Tracer Tests with Implications for Contaminant Transport Modeling - A Project Summary,
W87-08759 5B

MENDELSOHN, R.
Modeling the Demand for Outdoor Recreation,
W87-09034 6D

MENDOZA, C. G.
Sensitivity of Chronic Endpoints Used in Daphnia Magna Straus Life-Cycle Tests,
W87-08642 5C

MENKEDICK, J. R.
Comparison of the Hydrophobic-Grid Membrane Filter Procedure and Standard Methods for Coliform Analysis of Water,
W87-09392 5A

MERCER, J. W
Basic Data Report for Drilling and Hydrologic Testing of Drillhole DOE-2 at the Waste Isolation Pilot Plant (WIPP) Site,
W87-09333 5E

MERRILL, E. P.
Concentration of Giardia Cysts from Water by a Centrifugal Cream Separator,
W87-09209 5A

MESSER, J.
Importance of Atmospheric Fluxes to the Nitrogen Balance of Lakes in the Florida Peninsula,
W87-09176 2H

METCALF, T. G.
A-ELISA to Detect Hepatitis A Virus in Estuarine Samples,
W87-09396 5A

METZGER, L.
Effect of Sewage Sludge on Soil Structural Stability: Microbiological Aspects,
W87-08997 5C

MEULEMANS, J. T.
Method for Measuring Selective Light Attenuation within a Periphytic Community,
W87-08769 7B

MEURISSE-GENIN, D. M.
Benthic Macroinvertebrates of the Meuse River in Belgium: A Review of Five Years of Research (1980-1984) (Les Macroinvertebres Benthiques de la Meuse Belge: Bilan de Cinq Annees de Recherches (1980 a 1984),
W87-08765 5C

MEYERS, P. A.
Organic Matter and Heavy Metal Concentrations in the Particulate Phase of Lake Michigan Surface Microlayers,
W87-09171 5B

MEYERS, R. J.
Response to the Esso Bayway Oil Spill,
W87-09549 5G

MEYERS, T. R.
Histopathology,
W87-09290 5C

MICHA, J.-C.
Benthic Macroinvertebrates of the Meuse River in Belgium: A Review of Five Years of Research (1980-1984) (Les Macroinvertebres Benthiques de la Meuse Belge: Bilan de Cinq Annees de Recherches (1980 a 1984),
W87-08765 5C

MICHAELS, H.
American West's Acid Rain Test,
W87-09160 5B

MICHEL, J.
Effects of Oil Spills on Mangrove Forests: A Comparison of Five Oil Spill Sites in the Gulf of Mexico and the Caribbean Sea,
W87-09558 5C

MIKELADZE, G. T.
Assignment of Strength Requirments of Concrete for Large Dams,
W87-09354 8F

MIKSIS, M.
Scanning Currents in Stokes Flow and the Efficient Feeding of Small Organisms,
W87-09385 2H

MILAZZO, D. P.
Sensitivity of Chronic Endpoints Used in Daphnia Magna Straus Life-Cycle Tests,
W87-08642 5C

MILL, T.
Photochemical Transformations,
W87-08682 5B

MILLER, A. C.
Effects of Intermittent Exposure to Suspended Solids and Turbulence on Three Species of Freshwater Mussels,
W87-09381 6G

MILLER, D. E.
Control of Furrow Erosion With Crop Residues and Surge Flow Irrigation,
W87-09003 3F

MILLER, D. F.
SO2 Oxidation in Cloud Drops Containing NaCl or Sea Salt as Condensation Nuclei,
W87-08950 6E

MILLER, G. W.
Structure and Regulation of the European Bottled Water Industry,
W87-09132 5F

MILLER, R. V.
Potential for Transduction of Plasmids in a Natural Freshwater Environment: Effect of Plasmid Donor Concentration and a Natural Microbial Community on Transduction in Pseudomonas aeruginosa,
W87-09390 2H

MILLIGAN, G. W. E.
BASIC Soil Mechanics,
W87-09307 8D

MILLIKEN, J. G.
Metropolitan Water Management,
W87-09338 6D

MILLINGTON, D. S.
By-Products of Chlorination: Specific Compounds and Their Relationship to Total Organic Halogen,
W87-09123 5F

MILLS, G. L.
Chromatographic Studies of Dissolved Organic Matter and Copper-Organic Complexes Isolated From Estuarine Waters,
W87-08960 7B

MILLS, W. B.
Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants, Part 1,
W87-09462 5B

MINCHIN, F. R.
Nitrogenase Activity, Photosynthesis and Nodule Water Potential in Soyabean Plants Experiencing Water Deprivation,
W87-08798 2I

MINELLO, T. J.
Fish Predation on Juvenile Brown Shrimp, Penaeus Aztecus Ives: Effects of Turbidity and Substratum on Predation Rates,
W87-09252 2H

MINGELGRIN, U.
Effect of Sewage Sludge on Soil Structural Stability: Microbiological Aspects,
W87-08997 5C

MISHRA, V. K.
Mineral Content of Grasses and Grasslands of the Himalayan Region: 2. Concentration of Trace and Major Elements in Grasses in Relation to Soil Properties and Climatic Factors,
W87-09256 2I

MISRA, S.
Evaluation of the Multitest Medium for Rapid Presumptive Identification of Vibrio cholerae from Environmental Sources,
W87-09397 5A

MIYAMOTO, J.
Comparative Metabolism of Fenitrothion in Aquatic Organisms: I. Metabolism in the Euryhaline Fish, Oryzias latipes and Mugil cephalus,
W87-08859 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: II. Metabolism in the Freshwater Snails, Cipangopaludina japonica and Physa acuta,
W87-08860 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: III. Metabolism in the Crustaceans, Daphnia pulex and Palaemon paucidens,
W87-08861 5B

MOBLEY, C. D.
Climate Forecast Verifications, U.S. Mainland, 1974-82,
W87-09499 2B

Data Intercomparison Theory I. Minimal Spanning Tree Tests for Location and Scale Differences,
W87-09501 7C

Data Intercomparison Theory II. Trinity Statistics for Location, Spread and Pattern Differences,
W87-09504 7C

Data Intercomparison Theory III. S-Phase and T-Phase Tests for Spatial Pattern and Temporal Evolution,
W87-09505 7C

Data Intercomparison Theory IV. Tercile Tests for Location, Spread and Pattern Differences,
W87-09503 7C

Data Intercomparison Theory V. Case Study: Effects of Objective Analysis on a Tropical Pacific Sea Surface Temperature Set,
W87-09502 7C

MOEN, P. D.
Focus: Fisheries Oceanography Cooperative Users System,
W87-09500 7C

MOHUN, J.
Drowning of a Culture,
W87-09231 6G

MOIN, P.
Turbulence Statistics in Fully Developed Channel Flow at Low Reynolds Number,
W87-09383 8B

MOLLARD, J. D.
Predicting Settlement at a Damsite on a Tunnel Valley Deposit in Alberta,
W87-08795 8A

MOLTYANER, G. L.
Comparison of Field and Laboratory Methods for Determining Contaminant Flow Parameters,
W87-08757 5B

MOLZ, F. J.
Performance and Analysis of Aquifer Tracer Tests with Implications for Contaminant Transport Modeling - A Project Summary,
W87-08759 5B

MONTERO, G. V.
Anaerobic Treatment of Distillery Slops Using an Upflow Anaerobic Filter Reactor,
W87-08890 5D

MONTERO, M. C.
Residues of Organochlorine Chemicals and Concentrations of Heavy Metals in Ciconiforme Eggs in Relation to Diet and Habitat,
W87-08916 5B

MONTGOMERY, B. R.
Vacuum Trough Extractors for Measuring Drainage and Nitrate Flux Through Sandy Soils,
W87-08989 7B

MONTGOMERY, R. M.
Effects of Triethylene Glycol on Mysidopsis bahia (Crustacea: Mysidacea) and Menidia peninsulae (Pisces: Atherinidae),
W87-08644 5C

Field Confirmation of a Laboratory-Derived Hazard Assessment of the Acute Toxicity of Fenthion to Pink Shrimp, Penaeus duorarum,
W87-08638 5C

MONTGOMERY, S. O.
Biodegradation of Trichloroethylene and Involvement of an Aromatic Biodegradative Pathway,
W87-09387 5D

MOO-YOUNG, M.
Scale-Up Experience with the Waterloo SCP Process in Industrial Biomass Waste Treatment,
W87-09455 5D

MOOLEY, D. A.
Empirical Prediction of the Summer Monsoon Rainfall over India,
W87-08940 2B

MOORE, L.
Disinfectant Chemistry In Drinking Water - Overview of Impacts on Drinking Water Quality,
W87-09122 5F

MOORE, W. M.
Potassium Ferrioxalate as Chemical Actinometer in Ultraviolet Reactors,
W87-09377 5F

MOORE, W. S.
Sedimentation and Bioturbation in a Salt Marsh as Revealed by 210Pb, 137Cs, and 7Be Studies,
W87-08932 2L

MOPPER, K.
Free Amino Acids in Marine Rains: Evidence for Oxidation and Potential Role in Nitrogen Cycling,
W87-09349 2B

MOR, G.
Exposure to Legionella in Geriatric Institutions,
W87-08907 5B

MOREL, F. M. M.
Adsorption of Inorganic Pollutants in Aquatic Systems,
W87-09194 5B

Principles of Aquatic Chemistry,
W87-09305 2K

MORGAN, J. J.
Aquatic Chemistry: An Introduction Emphasizing Chemical Equilibria in Natural Waters,
W87-09340 2A

MORNHINWEG, D. W.
Leaf Photosynthesis and Conductance of Selected Triticum Species at Different Water Potentials,
W87-09419 2I

MORRIS, D. H.
Prehistoric Hunter-Gatherers of South Central Arizona: The Picacho Reservoir Archaic Project,
W87-09191 6G

MORRIS, P. R.
Use of Dispersants on Viscous Fuel Oils and Water in Crude Oil Emulsions,
W87-09511 5G

MORRIS, R. W.
Distribution of Aromatic Hydrocarbons in Port Valdez, Alaska,
W87-09513 5B

MORRIS, S. C.
Environmental Aspects of Energy Related Solid Waste,
W87-09427 5E

MOSCONI, C. E.
Streambank Protection by Submerged Vanes,
W87-09198 4D

MOSER, P.
Limits of Bioaccumulation of Organic Pigments in Fish: Their Relation to the Partition Coefficient and the Solubility in Water and Octanol,
W87-08853 5B

MOSER, R.
Turbulence Statistics in Fully Developed Channel Flow at Low Reynolds Number,
W87-09383 8B

MOSETTI, R.
Optimization of Closure Operations in a Tidal Basin During a Storm-Surge,
W87-08610 4A

MOSNA, J.
Some Hydrogeological Solutions to the Exploitation of Underground Lignite Mines (Quelques Solutions Hydrogeologiques dans la Construction des Mines de Lignite Souterraines),
W87-09597 4B

MOSTAFA, I. Y.
Fate of 14C-Lindane in a Rice-Fish Model Ecosystem,
W87-08915 5B

MOTT, H. V.
Metal Precipitation in Two Landfill Leachates,
W87-09368 5G

MOUAT, M. C. H.
Influence of Soil Water Content on the Supply of Phosphate to Plants,
W87-08705 2I

MOUNT, D. I.
Appropriate Durations and Measures for Ceriodaphnia Toxicity Tests,
W87-08654 5C

MOWLI, P.
Desorption and Regeneration of Dye Colours from Low-Cost Materials,
W87-09279 5D

MTETWA, E. G.
Biological Denitrification of a Highly Nitrogenous Industrial Effluent: A Case Study in Zimbabwe,
W87-08964 5D

MUDROCH, A.
Transport of Arsenic and Mercury from Gold Mining Activities Through an Aquatic System,
W87-08731 5B

MUELLER, L.
Biological Effects of Continuous and Intermittent Dosing of Outdoor Experimental Streams with Chloropyrifos,
W87-08634 5C

MUENSTER, U.
Geochemistry and Ecological Role of Humic Substances in Lakewater,
W87-09071 2H

MUESSIG, L. F.
Sedimentation in Lake Onalaska, Navigation Pool 7, Upper Mississippi River, Since Impoundment,
W87-08969 2J

MUIR, D. C. G.
Bioconcentration of Four Chlorinated Dioxins by Rainbow Trout and Fathead Minnows,
W87-08659 5B

MULQUEEN, J.
Hydrology and Drainage of Peatland,
W87-09201 2G

MULVIHILL, E. A.
Numerical Simulation of the Effects of Varying Ice Crystal Nucleation Rates and Aggregation Processes on Orographic Snowfall,
W87-08697 2B

MUNGER, J. W.
Trace Metal and Strong Acid Composition of Rain and Snow in Northern Minnesota,
W87-09178 5B

MUNTAU, H.
Trace and Nutrient Element Transfer from Sewage Sludge-Amended Soil to Crops: A Study on Brassica oleracea,
W87-08917 5B

MUNZ, C.
Air-Water Phase Equilibria of Volatile Organic Solutes,
W87-08956 5F

MURAI, Y.
Spectrophotometric Determination of Traces of Silicon in Water after Collection as Silicomolybdenum Blue on an Organic-Solvent-Soluble Membrane Filter,
W87-08833 5A

MURATANI, T.
Chemical Changes of Organic Compounds in Chlorinated Water: XII. Gas Chromatographic-Mass Spectrometric Studies of the Reactions of Methylnaphthalenes with Hypochlorite in Dilute Aqueous Solution,
W87-09224 2K

MURPHY, T. J.
Inputs of Polychlorinated Biphenyls from the Atmosphere to Lakes Huron and Michigan,
W87-09186 5B

MURRAY, B. C.
Embankment Dam Instrumentation Manual,
W87-09157 8A

MURRAY, H. E.
Establishment of Biotic Communities Within a Newly Constructed Ash Settling Basin and Its Drainage System,
W87-09323 5E

MUTENIA, A.
Development of Fish Stock and Fish Populations in Lake Inari,
W87-09054 2H

Fish Stocks and Fishing in the Lokka and Porttipahta Reservoirs, Northern Finland,
W87-09056 2H

MUZAS, F.
Special Techniques of Ground Treatment in Mining Works (Las Tecnicas Especiales de Tratamiento del Terreno en los Trabajos de Mineria),
W87-09598 4B

MYKYTIUK, A. P.
Determination of Trace Metals in a River Water Reference Material by Inductively Coupled Plasma Mass Spectrometry,
W87-08832 5A

MYRABO, S.
Runoff Studies in a Small Catchment,
W87-08822 2E

NACCI, D. E.
Rapid Aquatic Toxicity Assay Using Incorporation of Tritiated-Thymidine into Sea Urchin, Arbacia punctulata, Embryo: Evaluation of Toxicant Exposure Procedures,
W87-08655 5C

NAF, C.
Characterization of the PAC Profile in Settling Particulates from the Urban Waters of Stockholm,
W87-09237 5B

NAIMAN, R. J.
Regulation of Riverine Fish Communities by a Continuum of Abiotic-Biotic Factors,
W87-09037 2H

NAIR, G. B.
Evaluation of the Multitest Medium for Rapid Presumptive Identification of Vibrio cholerae from Environmental Sources,
W87-09397 5A

NAIR, M. R. G. K.
Effect of Irrigation on Persistent Toxicity of Insecticides Applied as Granules to Soil to Brown Plant Hopper and Rice Swarming Caterpillar,
W87-08897 5B

NASH, J. H.
Coherent, Plunging Water Jets for Oil Spill Control,
W87-09565 5G

NASSER, A. M.
A-ELISA to Detect Hepatitis A Virus in Estuarine Samples,
W87-09396 5A

NAVARRETE-GUIJOSA, A.
Adsorption of 2,4,5-T by Active Carbons from Aqueous Solution,
W87-09254 5D

Study of the Kinetics of the Adsorption by Activated Carbons of 2,4,5-Trichlorophenoxyacetic Acid from Aqueous Solution,
W87-09251 5D

NAVEH, Z.
Pasture and Forest Management in the Mediterranean Uplands,
W87-08665 3F

NAW, M. S.
Importance of Laboratory Scale Study for the Design of Mobile-Bed Filter,
W87-09442 5F

NEAL, P.
Atlantic Empress Sinking - A Large Spill Without Environmental Disaster,
W87-09553 5C

NEAL, R. A.
Chemicals and Safe Drinking Water: National and International Perspective,
W87-09115 5C

NEARING, M. A.
Relationships Between Waterdrop Properties and Forces of Impact,
W87-09004 2J

NEELY, W. B.
Hydrolysis,
W87-08681 5B

Model for Estimating the Loading Rate of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin to the Great Lakes,
W87-08660 5B

NEFF, J. M.
Impact of the Esso Bayway Oil Spill on Salt Marsh Macro Fauna,
W87-09550 5C

Polycyclic Aromatic Hydrocarbons,
W87-09293 5C

Response of Marine Animals to Petroleum and Specific Petroleum Hydrocarbons,
W87-09308 5C

NEITZEL, D. A.
Effects of Suspended Volcanic Ash and Thermal Shock on Susceptibility of Juvenile Salmonids to Disease,
W87-08653 5C

NELLIAT, E. V.
Influence of Long Term Cultural Operations on Physical and Water Retention Characters of a Red Sandy Loam Soil,
W87-08773 2G

NELSON, M. J. K.
Biodegradation of Trichloroethylene and Involvement of an Aromatic Biodegradative Pathway,
W87-09387 5D

NELSON, R. W.
Wetlands Policy Crisis: United States and United Kingdom,
W87-09215 6E

NES, P.
Influence of Soil Water Content on the Supply of Phosphate to Plants,
W87-08705 2I

NESTMANN, F.
Optimization of Mechanical Aerators in a Hydraulic Two-Phase Flow Model and the Scale-Up of the Results for the Prototype,
W87-09439 5D

NEUNER, R. G.
Cooperative Solution for a Water System 'Emergency',
W87-08807 5F

NEVALAINEN, A.
Ammonia, Hydrogen Sulphide and Methyl Mercaptides in Finnish Municipal Sewage Plants and Pumping Stations,
W87-08725 5D

NEWHOOK, R.
Bacteria as Structuring Agents in Lakes: Field Manipulations with Bacterioplankton,
W87-08768 2H

NEWMAN, J. R.
Manual of Stream Channelization Impacts on Fish and Wildlife,
W87-09497 6G

NG, W. J.
Biodegradation of Phenols in an Integrated Activated Carbon Bed and Suspended Aerobic Biological Growth Reactor,
W87-08774 5D

NIBLING, F. L.
Biological Control of Aquatic Weeds: The Efficacy of Hybrid Grass Carp in Two Southern California Irrigation Canals,
W87-09480 4A

NICHOLS, J. C.
Impact of Trinitrotoluene Wastewaters on Aquatic Biota in Lake Chickamauga, Tennessee,
W87-09322 5C

NICOLA, R. M.
Chemical Contaminants in Bottomfish,
W87-09035 5B

NICOLAOU, N. G.
Problems of Water Inrush into Greek Underground Mines with Special Emphasis to Sea Water Inrush Through Karstic Limestones or Impermeable Formations,
W87-09596 2F

NIEBOER, E.
Lichens as Monitors of Atmospheric Deposition,
W87-09181 5C

NIEMI, A.
Whitefish and Vendace Stocks in the Regulated Lake Pyhajarvi, Central Finland,
W87-09052 2H

NIFONTOVA, M. G.
90Sr and 137Cs in Peat Deposits of Low-Lying Bog in the Influence Zone of the Beloyarsk Atomic Power Station,
W87-08710 5B

NIGHTINGALE, H. I.
Water Quality Beneath Urban Runoff Water Management Basins,
W87-08967 2F

NIKOLAEV, I. I.
Ecological Consequences of Artificial Changes in the Water Regime of Lakes and Their Significance for Forecasting,
W87-08708 6G

NIMMO, D. R.
Pesticides,
W87-09291 5C

NISHIIZUMI, K.
In Situ Cosmogenic 3H, 14C, and 10Be for Determining the Net Accumulation and Ablation Rates of Ice Sheets,
W87-09249 2C

NIWAS, J. M.
Heavy Metal Pollution of the Mid-Canal of Kandy: An Environmental Case Study from Sri Lanka,
W87-08840 5C

NOBERT, M.
Rainfall Acidity as Related to Meteorological Parameters in Northern Quebec,
W87-08943 2B

NOBLE, P. S.
Temperature Modelling of Wet and Dry Desert Soils,
W87-08791 2G

NOBLET, G. P.
Seasonal Distribution of Thermotolerant Free-Living Amoebae. II. Lake Issaqueena,
W87-09225 2H

NOEL, J.
Concentrations of Mercury in Near Shore Surface Waters of the Bay of Biscay and in the Gironde Estuary,
W87-08961 5A

NONAKA, M.
Wastewater Treatment System Applying Aeration-Cavitation Flotation Mechanism,
W87-08603 5D

NOREN, K.
Analysis of Pentachlorophenol in Water and Urine by Enrichment with Lipidex(R) 5000,
W87-08896 5A

NORTON, S. A.
Rates of Accumulation of Heavy Metals in Pre- and Post-European Sediments in New England Lakes,
W87-09184 5B

NORWOOD, D. L.
By-Products of Chlorination: Specific Compounds and Their Relationship to Total Organic Halogen,
W87-09123 5F

NOVODEREZHKIN, R. A.
Programmed Closing of Gates Upon Loss of Drive by a Pump Unit,
W87-09355 8C

NOWICKI, M.
Epidemiological Evidence of Legionellosis Transmission through Domestic Hot Water Supply Systems and Possibilities of Control,
W87-08905 5F

NRIAGU, J. O.
Chemistry of the River Niger I. Major Ions,
W87-08719 2K

Chemistry of the River Niger II. Trace Metals,
W87-08720 2K

Response of Lake Sediments to Changes in Trace Metal Emission from the Smelters at Sudbury, Ontario,
W87-09245 5B

NYAMAPFENE, K. W.
Biological Denitrification of a Highly Nitrogenous Industrial Effluent: A Case Study in Zimbabwe,
W87-08964 5D

NYITRAY, A. M.
Leaching Behaviors of Low-Sulfur Coals and Coal Wastes from Three Western Coal Preparation Plants,
W87-09429 5B

O'CONNOR, M. J.
Contamination of Groundwater by Hydrocarbons from a Refinery - A Case History,
W87-09547 5G

O'MELIA, C. R.
Optimal Water Treatment Plant Design,
W87-09374 5F

O'NEILL, P.
Temporal Observations of Surface Soil Moisture Using A Passive Microwave Sensor,
W87-08781 2G

O'NEILL, T. K.
Groundwater-Leachate: Modeling/Monitoring/Sampling,
W87-09089 5B

O'ROURKE, J. A.
Leaching Behaviors of Low-Sulfur Coals and Coal Wastes from Three Western Coal Preparation Plants,
W87-09429 5B

O'TOOLE, J. C.
Changes at Panicle Emergence in the Water Relations of a Wetland and a Dryland Japonica Rice Cultivar Under Wetland Conditions,
W87-09415 2I

OAKLEY, S. A.
Physical and Chemical Behavior and Environmental Acceptability of Stabilized Scrubber Sludge and Fly Ash in Seawater,
W87-09327 5B

OBAYASHI, A. W.
Management of Industrial Pollutants by Anaerobic Processes,
W87-09190 5D

ODGAARD, A. J.
Fish Diversion in Hydropower Intake,
W87-09197 8I

Streambank Protection by Submerged Vanes,
W87-09198 4D

OGANGA, A. O.
Public Health Significance of Industrial Pollution in Zaria, Nigeria,
W87-09226 5B

OGUNSEITAN, O.
Potential for Transduction of Plasmids in a Natural Freshwater Environment: Effect of Plasmid Donor Concentration and a Natural Microbial Community on Transduction in Pseudomonas aeruginosa,
W87-09390 2H

OHSHIMA, M.
Comparative Metabolism of Fenitrothion in Aquatic Organisms: I. Metabolism in the Euryhaline Fish, Oryzias latipes and Mugil cephalus,
W87-08859 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: II. Metabolism in the Freshwater Snails, Cipangopaludina japonica and Physa acuta,
W87-08860 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: III. Metabolism in the Crustaceans, Daphnia pulex and Palaemon paucidens,
W87-08861 5B

OKLA, L.
Attempt to Measure the Flow of Chlorinated Hydrocarbons, such as PCBs, from Water to Air in the Field,
W87-09246 7B

OLAFSSON, P. G.
Disposition of Low and High Environmental Concentrations of PCBs in Snapping Turtle Tissues,
W87-09234 5B

OLDSHUE, J. Y.
Perspectives on the Scale-Up of Impeller Mixers,
W87-09434 5D

OLECK, B. M.
Survival and Multiplication of Legionella pneumophila in Municipal Drinking Water Systems,
W87-09389 5F

OLIMPIEV, D. N.
Considertion of the Stress-Strain State in Calculations of Slope Stability of Earth Dams,
W87-09356 8D

OLIVEIRA, C. A. S.
Field Method for Estimating Hydraulic Conductivity and Matric Potential-Water Content Relations,
W87-08993 2G

OLIVER, G. R.
Aquatic Hazard Assessment: Picloram,
W87-08643 5C

OLIVER, J. L.
Thermal and Dissolved Oxygen Characteristics of a South Carolina Cooling Reservoir,
W87-08975 2H

OLSEN, R. L.
Distribution Coefficient of Trichloroethylene in Soil-Water Systems,
W87-08752 5B

OLSON, K. R.
Method to Estimate Soil Loss From Erosion,
W87-09007 7B

OLSON, M. M.
Power-Plant-Related Estuarine Zooplankton Studies,
W87-09316 5C

OLSSON, T.
Hydrogeological Aspects of Ground Water Inflow in the Juktan Tunnels, Sweden,
W87-09591 2F

ONODERA, S.
Chemical Changes of Organic Compounds in Chlorinated Water: XII. Gas Chromatographic-Mass Spectrometric Studies of the Reactions of Methylnaphthalenes with Hypochlorite in Dilute Aqueous Solution,
W87-09224 2K

OPALUCH, J. J.
Nonpoint Agricultural Pollution: Pesticide Contamination of Groundwater Supplies,
W87-09213 5B

ORVINI, E.
Trace and Nutrient Element Transfer from Sewage Sludge-Amended Soil to Crops: A Study on Brassica oleracea,
W87-08917 5B

OSMELOSKI, J.
Influence of Simulated Acidic Rain on Vegetative and Reproductive Tissues of Cucumber (Cucumis sativus L.),
W87-09232 5C

OSMELOSKI, J. F.
Effects of Simulated Acidic Mist on Germination of Alternaria solani and Phytophthora infestans in vitro and their Infection Efficiency and Sporulation on Potato,
W87-09414 5C

OSTENDORF, D. W.
Sediment Diffusion in Primary Shallow Rectangular Clarifiers,
W87-09376 5F

OTTO, C.
Influence of Substrate Stability on the Composition of Stream Benthos: An Experimental Study,
W87-09403 2H

OTTOLENGHI, A. C.
Multiyear Study of Sludge Application to Farmland: Prevalence of Bacterial Enteric Pathogens and Antibody Status of Farm Families,
W87-09394 5C

OVERCASH, M. R.
Swine Lagoon Effluent Applied to Coastal Bermudagrass,
W87-09472 5D

Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: I. Persistence, Yield, Quality, and Elemental Removal,
W87-08919 5C

Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: II. Rainfall Runoff and Soil Chemical Properties,
W87-08920 5C

OWEN, R. M.
Organic Matter and Heavy Metal Concentrations in the Particulate Phase of Lake Michigan Surface Microlayers,
W87-09171 5B

OWENS, E. H.
Spill Impacts and Shoreline Cleanup Operations on Arctic and Sub-Arctic Coasts,
W87-09538 5G

OZOUVILLE, L. D.
Geomorphological Alteration of a Heavily Oiled Saltmarsh (Ile Grande, France) as a Result of Massive Cleanup,
W87-09543 5B

PACHECO, M. V.
Anaerobic Treatment of Distillery Slops Using an Upflow Anaerobic Filter Reactor,
W87-08890 5D

PACIA, D.
Maintenance and Stability of Introduced Genotypes in Groundwater Aquifer Material,
W87-09391 5B

PAETZOLD, R. F.
Pulsed Nuclear Magnetic Resonance Instrument for Soil-Water Content Measurement: Sensor Configurations,
W87-08991 7B

PAGE, D. S.
Fate of the Zoe Colocotroni Oil Spill and its Effects on Infaunal Communities Associated with Mangroves,
W87-09544 5C

PAGENKOPF, J.
Dredged Material Containment in Long Island Sound (With Special Emphasis on Eastern New York Waters),
W87-09474 8A

PAINULI, D. K.
Effect of Exchangeable Sodium Percent on Surface Sealing,
W87-08742 4D

PAL, R.
Improvement of Irrigation Water by Gypsum Beds,
W87-08745 5G

PAL, S. C.
Evaluation of the Multitest Medium for Rapid Presumptive Identification of Vibrio cholerae from Environmental Sources,
W87-09397 5A

PALANISAMI, K.
Small-Scale Surface (Tank) Irrigation in Asia,
W87-09015 3F

PALAZZOLA, R. M.
Development of a New Type of Fluidized Bed Reactor,
W87-09444 5D

PALMER, M. A.
Hydrodynamics and Structure: Interactive Effects on Meiofauna Dispersal,
W87-08838 2L

PALOMAKI, R.
Whitefish and Vendace Stocks in the Regulated Lake Pyhajarvi, Central Finland,
W87-09052 2H

PAOLUCCI, G.
Inputs of Polychlorinated Biphenyls from the Atmosphere to Lakes Huron and Michigan,
W87-09186 5B

PARAZAK, D. P.
Determination of Low Levels of Cationic Polyelectrolytes in Water,
W87-08986 5A

PARKER, D. S.
Relationship Between Bench Scale and Prototype Activated Sludge Systems,
W87-09449 5D

PARKER, J. C.
Finite Element Analysis of Water Flow in Variably Saturated Soil,
W87-08620 2G

PARKER, J. H.
Physical and Chemical Behavior and Environmental Acceptability of Stabilized Scrubber Sludge and Fly Ash in Seawater,
W87-09327 5B

PARKER, K. S.
Focus: Fisheries Oceanography Cooperative Users System,
W87-09500 7C

PARKER, M.
Effect of Beaver Ponds on the Nonpoint Source Water Quality of a Stream in Southwestern Wyoming,
W87-09265 2H

PARLANGE, J.-Y.
Capillarity Correction for Free Surface Flow of Groundwater,
W87-09018 2F

PARNELL, R. A.
Mobilization of Aluminum in a Natural Soil System: Effects of Hydrologic Pathways,
W87-09024 5B

PARRISH, P. R.
Acute Toxicity Tests,
W87-09281 5C

PARSONS, D. J.
Economics of the Treatment of Dairy Cow Slurry by Anaerobic Digestion,
W87-09216 5D

PARSONS, J. W.
Coastal Ecosystem Studies and Their Application to Oil Spill Response,
W87-09539 5C

PASQUARELL, G. C.
Winter Flow, Ice, and Weather Conditions of the Upper St. Lawrence River, 1971-81; Volume I: Ice Cover Charts (Part A),
W87-09475 2E

PASTERNAK, D.
Irrigation with Brackish Water under Desert Conditions: IV. Salt Tolerance Studies with Lettuce (Lactuca sativa L.),
W87-08746 3C

Irrigation with Brackish Water under Desert Conditions: V. Nitrogen Requirement of Tomatoes (Lycopersicon esculentum Mill.) during Germination under Drip Irrigation,
W87-08747 3C

PATERSON, S.
Equilibrium Models for the Initial Integration of Physical and Chemical Properties,
W87-08683 5B

PATRICK, J. M.
Field Confirmation of a Laboratory-Derived Hazard Assessment of the Acute Toxicity of Fenthion to Pink Shrimp, Penaeus duorarum,
W87-08638 5C

PAUCOD, J. C.
Epidemiological Evidence of Legionellosis Transmission through Domestic Hot Water Supply Systems and Possibilities of Control,
W87-08905 5F

PAUL, E. A.
Vulnerability of Selected Lakes and Streams in the Middle Atlantic Region to Acidification: A Regional Survey,
W87-09476 5B

PAVIA, R.
Burmah Agate - Chronology and Containment Operations,
W87-09519 5B

PAVLIN, B.
Protection of the Karstic Springs System in Golubinka Against Contamination by the Sea Water (la Protection du Systeme des Sources Karstiques de Golubinka Contre la Contamination par la Mer),
W87-09582 4B

PAYNE, B. S.
Effects of Intermittent Exposure to Suspended Solids and Turbulence on Three Species of Freshwater Mussels,
W87-09381 6G

PAYNE, J. R.
Petroleum Spills in the Marine Environment: The Chemistry and Formation of Water-in-Oil Emulsions and Tar Balls,
W87-09339 5B

PEARSON, N. S.
Impact of Simulated Acidic Precipitation on Quantity and Quality of a Field Grown Potato Crop,
W87-08789 5C

PEARSON, R. G.
Effects of Pollution by Organic Sugar Mill Effluent on the Macro-invertebrates of a Stream in Tropical Queensland, Australia,
W87-09421 5C

PEARSON, W.
Short-Term Effects of Polynuclear Aromatic Hydrocarbons on Sea-Surface Microlayer Phytoneuston,
W87-09238 5C

PEDEN, M. E.
Theory and Practice in the Electrometric Determination of pH in Precipitation,
W87-08949 7B

PEDROS-ALIO, C.
Ecology of a Cryptomonas phaseolus Population Forming a Metalimnetic Bloom in Lake Ciso, Spain: Annual Distribution and Loss Factors,
W87-08930 2H

PELET, R.
Geochemistry of Humic Substances in Marine Sediments,
W87-09076 2J

PELL, E. J.
Impact of Simulated Acidic Precipitation on Quantity and Quality of a Field Grown Potato Crop,
W87-08789 5C

PELON, W.
Growth of Mixed Microbial Populations in Ground Water Containing Highly Chlorinated Organic Wastes,
W87-08878 5B

PENNEY, B. W.
Removal of Multivalent Metal Cations from Water Using Micellular-Enhanced Ultrafiltration,
W87-09223 2K

PENRIDGE, L. K.
Effects of Pollution by Organic Sugar Mill Effluent on the Macro-invertebrates of a Stream in Tropical Queensland, Australia,
W87-09421 5C

PEON PELAEZ, A.
Origin and Dynamics of the Waters Flowing into the Mining Works in Reocin (Santander, Spain) (Sobre el Origen y Dinamica de las Aguas Fluyentes a las Explotaciones Mineras de Reocin (Santander, Espana)),
W87-09586 2F

Preliminary Hydrogeological Study of the Reocin Mine (Santander, Spain) (Estudio Hidrogeologico Preliminar de la Mina de Reocin (Santander, Espana)),
W87-09579 2F

PERDUE, E. M.
Acidic Functional Groups of Humic Substances,
W87-09086 2K

PERKINS, G.
Distribution of Aromatic Hydrocarbons in Port Valdez, Alaska,
W87-09513 5B

Effectiveness of Offshore Produced Water Treatment,
W87-09515 5D

PERKINS, M. G.
Effect of 'Whiting' on Optical Properties and Turbidity in Owasco Lake, New York,
W87-08966 2H

PESTANA, M. H. D.
Geochemical Partitioning of Heavy Metals in Sediments of Three Estuaries Along the Coast of Rio de Janeiro (Brazil),
W87-08717 2L

PETEERS, E. G.
Possible Influence of the Components of the Soil and Lithosphere on the Development and Growth of Neoplasms,
W87-08693 2K

PETROCELLI, S. R.
Chronic Toxicity Tests,
W87-09283 5C

PETRUCCI, V. E.
Artificial Ground Water Recharge by Flooding During Grapevine Dormancy,
W87-08979 2F

PEYTON, B. M.
Photolytic Ozonation for Protection and Rehabilitation of Ground-Water Resources; A Mechanistic Study,
W87-09092 5G

PEYTON, G. R.
Photolytic Ozonation for Protection and Rehabilitation of Ground-Water Resources; A Mechanistic Study,
W87-09092 5G

PFEIFFER, W. C.
Heavy Metal Pollution in the Paraiba do Sul River, Brazil,
W87-08718 5B

PHARM, B.
Drinking Water: A Global Victual,
W87-09116 5C

World Health Organization and Guidelines and European Economic Community Directives,
W87-09130 6E

PHENE, C. J.
Traveling Trickle Irrigation System,
W87-09465 3F

PHIEN, H. N.
Review of Methods of Parameter Estimation for the Extreme Value Type-1 Distribution,
W87-08619 7C

PHILLIPS, C. R.
Petroleum Spills in the Marine Environment: The Chemistry and Formation of Water-in-Oil Emulsions and Tar Balls,
W87-09339 5B

PHILLIPS, D. M.
Impact of Oil on Marsh Communities in the St. Lawrence River,
W87-09541 5C

PICER, M.
Chlorinated Insecticides and PCBs in Asteroidea and Holothuroidea Species from Rijeka Bay, Yugoslavia,
W87-08724 5B

PICER, N.
Chlorinated Insecticides and PCBs in Asteroidea and Holothuroidea Species from Rijeka Bay, Yugoslavia,
W87-08724 5B

PICKERING, Q. H.
Acute and Chronic Toxicity to the Fathead Minnow, Pimephales promelas, of Effluents from a Treatment Plant Receiving Dye and Pigment Processing Wastewater,
W87-08656 5C

PIERCE, D.
Chemical Contaminants in Bottomfish,
W87-09035 5B

PIETAK, A.
Application of New Chemical Grouts in Strengthening and Sealing of Soils,
W87-09594 8G

PIK, A.
Exposure to Legionella in Geriatric Institutions,
W87-08907 5B

PIKE, W. S.
Longer-Duration Post-Frontal Precipitation at Vancouver International Airport, 1953-1983,
W87-08809 2B

PIKUL, J. L.
Point Probability Distributions of Frozen Soil,
W87-08696 2C

PILLAI, K. S.
Effect of Irrigation on Persistent Toxicity of Insecticides Applied as Granules to Soil to Brown Plant Hopper and Rice Swarming Caterpillar,
W87-08897 5B

PILLARD, D. A.
Hexavalent Chromium Effects on Carbon Assimilation in Selenastrum capricornutum,
W87-08886 5C

PISTRUZAK, W. M.
Dome Petroleum's Oil Spill Research and Development Program for the Arctic,
W87-09524 5G

Dome's Petroleum Study of Oil and Gas Under Sea Ice,
W87-09525 5G

PLANAS, D.
Comparative Effects of Mine Wastes on the Benthos of an Acid and an Alkaline Pond,
W87-08962 5C

PODMORE, T. H.
Surge Irrigation Management,
W87-08744 3F

PODNIESINSKI, G. S.
Seasonality of Blue Mussel, Mytilus edulis L., Larvae in the Damariscotta River Estuary, Maine, 1969-77,
W87-08849 2L

POLLSKII, O. V.
Determination of Maximum Design Discharges,
W87-09362 2E

POONIA, S. R.
Improvement of Irrigation Water by Gypsum Beds,
W87-08745 5G

PORCELLA, D. B.
Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants, Part 1,
W87-09462 5B

POSPELOV, B. B.
Programmed Closing of Gates Upon Loss of Drive by a Pump Unit,
W87-09355 8C

POSTON, T. M.
Effects of Suspended Volcanic Ash and Thermal Shock on Susceptibility of Juvenile Salmonids to Disease,
W87-08653 5C

POTTER, D. A.
Interaction of Euonymus scale (Homoptera:Diaspididae) Feeding Damage and Severe Water Stress on Leaff Abscission and Growth of Euonymus Fortunei,
W87-09344 2I

POTTER, K. W.
Estimating Baseflow Volume and its Uncertainty,
W87-08971 2E

PRAVDIVETS, Y. P.
Model of Stability of Revetments of Earth Spillway Slopes,
W87-09357 8D

PREISENDORFER, R. W.
Climate Forecast Verifications, U.S. Mainland, 1974-82,
W87-09499 2B

Data Intercomparison Theory I. Minimal Spanning Tree Tests for Location and Scale Differences,
W87-09501 7C

Data Intercomparison Theory II. Trinity Statistics for Location, Spread and Pattern Differences,
W87-09504 7C

Data Intercomparison Theory III. S-Phase and T-Phase Tests for Spatial Pattern and Temporal Evolution,
W87-09505 7C

Data Intercomparison Theory IV. Tercile Tests for Location, Spread and Pattern Differences,
W87-09503 7C

Data Intercomparison Theory V. Case Study: Effects of Objective Analysis on a Tropical Pacific Sea Surface Temperature Set,
W87-09502 7C

Theory of Fluorescent Irradiance Fields in Lakes and Seas,
W87-09193 5A

PREMAZZI, G.
Correlation of a Lake Eutrophication Model to Field Experiments,
W87-08900 2H

PRENZEL, J.
Dynamics of Sulfate Retention by Acid Forest Soils in an Acidic Deposition Environment,
W87-09008 5B

PREVOST, J.-H.
2-D Elastoplastic Seismic Shear Response of Earth Dams: Applications,
W87-08608 8A

2-D Elastoplastic Seismic Shear Response of Earth Dams: Theory,
W87-08607 8A

PRICE, M.
British Examples of a Hydrogeological Approach to the Evaluation of Drainage Problems in Subsurface Engineering,
W87-09593 2F

PRIHAR, S. S.
Synthesis of a Simplified Water Use Simulation Model for Predicting Wheat Yields,
W87-09028 2I

PRISCU, J. C.
Photosynthate Distribution by Microplankton in Permanently Ice-Covered Antarctic Desert Lakes,
W87-08872 2H

PRISCU, L. R.
Photosynthate Distribution by Microplankton in Permanently Ice-Covered Antarctic Desert Lakes,
W87-08872 2H

PRITCHARD, P. H.
Biodegradation of Trichloroethylene and Involvement of an Aromatic Biodegradative Pathway,
W87-09387 5D

Microbial Toxicity Studies,
W87-09287 5C

PROULX, H.
Application of Meteorological Radar Data for Simulation of Streamflow with a Hydrological Matrix Model (Utilisation des Donnees d'un Radar Meteorologique pour la Simulation des Ecoulements en Riviere a l'aide d'un Modele Hydrologique Matriciel),
W87-08623 7B

PRUITT, B. C.
Impact of Trinitrotoluene Wastewaters on Aquatic Biota in Lake Chickamauga, Tennessee,
W87-09322 5C

PRUNTY, L.
Vacuum Trough Extractors for Measuring Drainage and Nitrate Flux Through Sandy Soils,
W87-08989 7B

PUCHKOVA, S. M.
Concrete Dam of the Denin Dnepr Hydroelectric Station,
W87-09352 8A

PUEL, D.
Statistical Assessment of a Sampling Pattern for Evaluation of Changes in Mercury and Zinc Concentrations in Patella coerulea,
W87-08884 5A

PULIDO-BOSCH, A.
Hydrogeological Problems Affecting the Exploitation of the Peat Bog at Padul (Granad, Spain). Preliminary Study (Problemas Hidrogeologicos que Afectan a la Explotacion de la Turbera de Padul (Granad, Espana). Estudio Preliminar),
W87-09576 4A

PUTNAM, H. D.
Impact of Trinitrotoluene Wastewaters on Aquatic Biota in Lake Chickamauga, Tennessee,
W87-09322 5C

Statistical Techniques for Evaluating Procedures and Results for Periphyton Sampling,
W87-09319 7C

PYASTOLOVA, O. A.
Growth and Development of Rana arvalis in Conditions Imitating Oil Contamination,
W87-08713 5C

QUAY, P. D.
Role of Gas Exchange in the Inorganic Carbon, Oxygen, and 222Rn Budgets of the Amazon River,
W87-08871 2H

QUICK, J. A.
What Industry is Doing to Protect Aquatic Life,
W87-08628 5G

QUINBY-HUNT, M. S.
Instrumentation for Environmental Monitoring, Volume 2: Water,
W87-09303 5A

QUINN, J. G.
Chromatographic Studies of Dissolved Organic Matter and Copper-Organic Complexes Isolated From Estuarine Waters,
W87-08960 7B

QUINTANILHA, A. T.
Instrumentation for Environmental Monitoring, Volume 2: Water,
W87-09303 5A

QUINTELA, A. C.
Roman Dams in Southern Portugal,
W87-09411 6E

QUIRK, T. P.
Scale-Up of Activated Sludge and Trickling Filter Processes,
W87-09451 5D

QUISENBERRY, J. E.
Use of Canopy Temperatures to Identify Water Conservation in Cotton Germplasm,
W87-08788 3F

QUISENBERRY, V. L.
Irrigation Practice for Crop Culture in the Southeastern United States,
W87-09466 3F

RABBANI, W. I.
Importance of Laboratory Scale Study for the Design of Mobile-Bed Filter,
W87-09442 5F

RABENHORST, M. C.
Carolina Bays on the Eastern Shore of Maryland: I. Soil Characterization and Classification,
W87-08999 2H

RACSKO, P.
Stability and Instability of an Adaptive Resource Replacement Strategy in and Agroecological Production System,
W87-08784 6A

RADWAY, J. C.
Microbially Mediated Leaching of Low-Sulfur Coal in Experimental Coal Columns,
W87-09393 5B

RAFTELIS, G. A.
Factors Affecting Water and Wastewater Rates,
W87-09221 6C

RAGAB, R. A.
Estimating Water Table Contribution to the Water Supply of Maize,
W87-08740 3F

RAJ, P. K.
Simplified Models to Predict the Breakup of Oil on Rough Seas,
W87-09521 5B

RAJPUT, G. S.
Water Production Functions for Wheat under Different Environmental Conditions,
W87-08748 3F

RAMAMURTHY, A. S.
Internal Hydraulics of Diffusers with Uniform Lateral Momentum Distribution,
W87-09366 8B

RAMPRASAD, G.
Desorption and Regeneration of Dye Colours from Low-Cost Materials,
W87-09279 5D

RAND, G. M.
Behavior,
W87-09288 5C

RANDALL, L.
Adsorptive Behavior of Butyltin Compounds Under Simulated Estuarine Conditions,
W87-08730 5B

RANDOLPH, M. S.
Effect of Crude Oil on Microbial Processes in Marine Sediments,
W87-09567 5C

RANGA RAJU, K. G.
Mechanics of Sediment Transportation and Alluvial Stream Problems,
W87-09337 2J

RANJIE, H.
Modelling of BOD-DO Dynamics in an Ice-Covered River in Northern China,
W87-09262 5B

RANSOME, L. S.
Soybean Growth and Boron Distribution in a Sandy Soil Amended with Scrubber Sludge,
W87-08927 5C

RAO, A. S.
Interception Losses of Rainfall from Cashew Trees,
W87-08621 2I

RAO, P. V. R.
Studies on Water Hyacinth as a Biological Filtre for Treating Contaminants from Agricultural Wastes and Industrial Effluents,
W87-08609 5D

RAO, S. S.
Response of Lake Sediments to Changes in Trace Metal Emission from the Smelters at Sudbury, Ontario,
W87-09245 5B

RAPER, W. G.
Important Issues in the Scale Up of New Processes,
W87-09435 5D

RATTNER, B. A.
Embryotoxicity, Teratogenicity, and Aryl Hydrocarbon Hydroxylase Activity in Forster's Terns on Green Bay, Lake Michigan,
W87-08841 5C

RAUBER, R. M.
Numerical Simulation of the Effects of Varying Ice Crystal Nucleation Rates and Aggregation Processes on Orographic Snowfall,
W87-08697 2B

SCPP Meteorological and Statistical Support for Period 1 September 1985, 31 August 1986, Volume I: Interim Progress Report,
W87-09334 2B

RAUTENSTRAUCH, K. R.
Preventing Desert Mule Deer Drownings in the Mohawk Canal, Arizona,
W87-09152 6G

RAVINA, I.
Application of Soil Conditioner Solutions to Soil Columns to Increase Water Stability of Aggregates,
W87-09005 2G

RAY, J. P.
1979 Southern California Dispersant Treated Research Oil Spills,
W87-09536 5G

RAY, P. K.
Correlation between Heavy Metal Acute Toxicity Values in Daphnia magna and Fish,
W87-08887 5A

RECTOR, B. M.
Distribution Coefficient of Trichloroethylene in Soil-Water Systems,
W87-08752 5B

REESE, A. J.
Design of Spillway Crests,
W87-09195 8A

REFSGAARD, A.
Laboratory Experiments on Solute Transport in Non-Homogeneous Porous Media,
W87-08819 5B

REFSGAARD, J. C.
WATBAL: A Semi-Distributed, Physically Based Hydrological Modelling System,
W87-08823 2G

REGUNATHAN, P.
Overview of Point-of-Use Water Treatment Technology,
W87-09119 5F

REHWOLDT, R. E.
Water Treatment Chemicals Codex,
W87-09121 5F

REID, R. A.
Input of Biologically Available Phosphorus by Precipitation to Precambrian Lakes,
W87-09174 5B

REINHARDT, W. G.
Puerto Rico Seeks Clean Water,
W87-08802 5D

REITER, G. A.
Cold Weather Response F/V Ryuyo Maru No. 2 St. Paul, Pribiloff Islands, Alaska,
W87-09529 5G

REPA, E. W.
Evaluating Asphalt Cap Effectiveness at Superfund Site,
W87-09379 5E

REPSYS, A. P.
Perennial Pasture Production after Irrigation with Saline Groundwater in the Goulburn Valley, Victoria,
W87-09208 3C

REVSBECH, N. P.
Photosynthesis and Light Adaptation in Epiphyte-Macrophyte Associations Measured by Oxygen Microelectrodes,
W87-08935 7B

REWICK, R. T.
Evaluation of Oil Spill Dispersant Testing Requirements,
W87-09508 5G

REYDAMS-DETOLLENAERE, A.
Benthic Macroinvertebrates of the Meuse River in Belgium: A Review of Five Years of Research (1980-1984) (Les Macroinvertebres Benthiques de la Meuse Belge: Bilan de Cinq Annees de Recherches (1980 a 1984),
W87-08765 5C

REYNOLDS, R. J.
Diffusivity of a Glacial-Outwash Aquifer by the Floodwave-Response Technique,
W87-08754 2F

RHOADES, J. D.
Reduction in Hydraulic Conductivity in Relation to Clay Dispersion and Disaggregation,
W87-08996 2G

RIBBE, P. H.
Factors Influencing Acute Toxicity of Coal Ash to Rainbow Trout (Salmo gairdneri) and Bluegill Sunfish (Lepomis macrochirus),
W87-08978 5C

RICE, E. W.
Occurrence, Significance, and Detection of Klebsiella in Water Systems,
W87-08958 5A

RICE, J. A.
Spectroscopic Methods (Other Than NMR) for Determining Functionality in Humic Substances,
W87-09087 7B

RICE, J. M.
Estimating Baseflow Volume and its Uncertainty,
W87-08971 2E

RICE, R. G.
Ozone for Drinking Water Treatment: A Bibliography,
W87-09147 5F

Ozone for Drinking Water Treatment - Evolution and Present Status,
W87-09124 5F

Recent Developments in the Treatment of Drinking Water with Ozone,
W87-09146 5F

Structure and Regulation of the European Bottled Water Industry,
W87-09132 5F

RICE, S. D.
Toxicity of Ballast-Water Treatment Effluent to Marine Organisms at Port Valdez, Alaska,
W87-09514 5C

RICH, L. A.
Water Treatment: The States Zero in on Groundwater Regulation,
W87-09222 5F

RICH, L. G.
Rational Design of Aerobic Digestion System,
W87-09370 5D

RICHARD, Y.
Control of Tastes and Odors in Drinking Water with Ozone,
W87-09137 5F

Removal of Ammonia and Other Nitrogen Derivatives from Drinking Water with Ozone,
W87-09141 5F

Removal of Color from Drinking Water with Ozone,
W87-09138 5F

Removal of Detergents from Drinking Water with Ozone,
W87-09139 5F

Removal of Pesticides from Drinking Water with Ozone,
W87-09140 5F

RICHARDS, D. R.
Low Freshwater Inflow Study: Chesapeake Bay Hydraulic Model Investigation,
W87-09484 2L

RICHARDSON, D. H. S.
Lichens as Monitors of Atmospheric Deposition,
W87-09181 5C

RICHARDSON, R. M.
Contamination of Groundwater by Hydrocarbons from a Refinery - A Case History,
W87-09547 5G

RICHARDSON, T. W.
Pumping Performance and Turbidity Generation of Model 600/100 Pneuma Pump: Main Text and Appendixes A and B,
W87-09487 8C

RICHEY, J. E.
Role of Gas Exchange in the Inorganic Carbon, Oxygen, and 222Rn Budgets of the Amazon River,
W87-08871 2H

RICHIE, E. B.
Elimination of Time Assignment Bias in Estimates of Dispersion Coefficient,
W87-08994 7C

RICKARD, W. H.
Trees as Indicators of Subterranean Water Flow from a Retired Radioactive Waste Disposal Site,
W87-08845 5A

RICO, M. C.
Residues of Organochlorine Chemicals and Concentrations of Heavy Metals in Ciconiforme Eggs in Relation to Diet and Habitat,
W87-08916 5B

RIHA, S. J.
Forest Soil Organic Horizon Acidification: Effects of Temperature, Time, and Solution/Soil Ratio,
W87-09009 2G

RILEY, R. G.
Toxicity of Chemically Dispersed Oil to Shrimp Exposed to Constant and Decreasing Concentrations in a Flowing System,
W87-09516 5C

RIVIER, B.
Physical and Biological Effects of Gravel Extraction in River Beds,
W87-09049 4C

RIZNYK, R. Z.
Short-Term Effects of Polynuclear Aromatic Hydrocarbons on Sea-Surface Microlayer Phytoneuston,
W87-09238 5C

ROBARGE, W. P.
Riparian Areas as Filters for Agricultural Sediment,
W87-09002 4A

ROBB, L.
Effects of Low Ambient pH on Perivitelline Fluid of Ambystoma maculatum (Shaw) Eggs,
W87-08963 5C

ROBBINS, C. H.
Man-Induced Gradient Adjustment of the South Fork Forked Deer River, West Tennessee,
W87-09206 6G

ROBERTS, G.
Effect of Upland Pasture Improvement on Nutrient Release in Flows from a 'Natural' Lysimeter and a Field Drain,
W87-08741 5G

ROBERTS, P. V.
Air-Water Phase Equilibria of Volatile Organic Solutes,
W87-08956 5F

ROBILLIARD, G. A.
Spill Impacts and Shoreline Cleanup Operations on Arctic and Sub-Arctic Coasts,
W87-09538 5G

ROBINSON, M.
Carcinogenic Effects in A/J Mice of Particulate of a Coal Tar Paint Used in Potable Water Systems,
W87-08613 5C

ROCCHIO, P. M.
Hexavalent Chromium Effects on Carbon Assimilation in Selenastrum capricornutum,
W87-08886 5C

RODHE, A.
Modelling Water Exchange and Transit Times in Till Basins Using Oxygen-18,
W87-08821 2A

ROESNER, L. A.
Quality of Urban Runoff,
W87-09102 5B

Urban Runoff Processes,
W87-09101 2A

ROETHEL, F. J.
Physical and Chemical Behavior and Environmental Acceptability of Stabilized Scrubber Sludge and Fly Ash in Seawater,
W87-09327 5B

ROGERS, A.
Effects on Salmonid Populations of Isolation of a Lake From a River System,
W87-09051 6G

ROGERS, J. W.
Advantages of Using Regression Analysis to Calculate Results of Chronic Toxicity Tests,
W87-08650 5C

ROGERS, L. L.
LLNL Groundwater Quality: Sampling of Seven Shallow Wells on the LLNL Site,
W87-09458 5B

ROSENBERG, F. A.
Antibiotic-Resistant Pseudomonas in Bottled Drinking Water,
W87-09424 5F

ROSEWELL, C. J.
Rainfall Kinetic Energy in Eastern Australia,
W87-08698 2B

ROSSI, G.
Correlation of a Lake Eutrophication Model to Field Experiments,
W87-08900 2H

ROTH, P.
American West's Acid Rain Test,
W87-09160 5B

ROUSSELLE, J.
Flood Damage Model for Flood Plain Studies,
W87-08965 2E

ROW, T. H.
Development Programs in the United States of America for the Application of Cement-Based Grouts in Radioactive Waste Management,
W87-09113 5E

ROWLAND, K. L.
Use of Bullfrogs (Rana catesbeiana) as Biological Markers for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin Contamination in the Environment,
W87-08733 5A

ROWLAND, S. J.
Fate and Effects of Dispersant-Treated Compared with Untreated Crude Oil, with Particular Reference to Sheltered Intertidal Sediments,
W87-09537 5G

RUBIN, A. J.
Determination of Monomeric and Polynuclear Aluminum(III) Species and Hydrolysis Constants,
W87-08611 1B

RUGGLES, R. W.
Winter Flow, Ice, and Weather Conditions of the Upper St. Lawrence River, 1971-81; Volume I: Ice Cover Charts (Part A),
W87-09475 2E

RUSSELL, P. P.
Application of Laboratory Scale Model Streams Toward Assessing Effluent Impacts in Freshwater Lotic Environments,
W87-09314 5C

RUSSO, R. C.
Ammonia, Nitrite, and Nitrate,
W87-09294 5C

RYAN, T. D.
Agricultural Drainage Practices in Ireland,
W87-09202 4A

RZESZUTKO, C. P.
Inputs of Polychlorinated Biphenyls from the Atmosphere to Lakes Huron and Michigan,
W87-09186 5B

SABINS, F. F.
Remote Sensing: Principles and Interpretation,
W87-09065 7B

SABO, K. A.
Evaluation of Oil Spill Dispersant Testing Requirements,
W87-09508 5G

SADD, J. L.
Impact and Persistence of Ixtoc I Oil on the South Texas Coast,
W87-09557 5C

SADEGHIPOUR, J.
Velocity Control as a Tool for Optimal Plume Containment in the Equus Beds Aquifer, Kansas,
W87-08982 5G

SAELTHUN, N. R.
New Procedures for Flood Estimation in Norway,
W87-08811 2E

SAFIULLAH, S.
Nature of Organic Matter in Rivers with Deep Sea Connections: The Ganges-Brahmaputra and Indus,
W87-08721 2H

SAGE, L. E.
Power-Plant-Related Estuarine Zooplankton Studies,
W87-09316 5C

SAHAI, R.
Effects of Distillery Waste on the Performance of Cicer arietinum L.,
W87-08873 5C

SAITO, K.
Suppression of Phosphate Liberation from Sediment by Using Iron Slag,
W87-09273 5G

SAKAMOTO, M.
Enhancement of Inorganic Nitrogen and Phosphate Release from Lake Sediment by Tubificid Worms and Chironomid Larvae,
W87-09404 2H

SALE, M. J.
Environmental Impact Analysis of Aquatic Ecosystems Using Rational Threshold Value Methodologies,
W87-09313 5C

SALEHI, R.
Bare Soil Evaporation Near a Surface Point-Source Emitter,
W87-08743 2D

SALIBA, B. C.
Irrigated Agriculture and Groundwater Quality--A Framework for Policy Development,
W87-09212 6A

SALIM, R.
Effect of Storage on the Distribution of Trace Elements (Lead, Cadmium, Copper, Zinc and Mercury) in Natural Water,
W87-08914 5A

SALONEN, K.
Three Day Study of the Diel Behaviour of Plankton in a Highly Humic and Steeply Stratified Lake,
W87-08766 2H

SALTANKIN, V. P.
Evaluations of the Recreational Potential of Reservoirs in Design Practice,
W87-09360 2H

SAND-JENSEN, K.
Photosynthesis and Light Adaptation in Epiphyte-Macrophyte Associations Measured by Oxygen Microelectrodes,
W87-08935 7B

SANDERS, J. R.
Effects of pH and Soil Type on Concentrations of Zinc, Copper and Nickel Extracted by Calcium Chloride from Sewage Sludge-Treated Soils,
W87-08911 5B

Zinc, Copper and Nickel Concentrations in Soil Extracts and Crops Grown on Four Soils Treated with Metal-loaded Sewage Sludges,
W87-09244 5B

SANDERS-LOEHR, J.
Induction of Siderophore Activity in Anabaena spp. and Its Moderation of Copper Toxicity,
W87-09386 5G

SANDERS, W. M.
Field Validation,
W87-09300 7A

SANDLUND, O. T.
Lake Effect on Stream Living Brown Trout (Salmo trutta),
W87-08763 2H

SANDS, D. P. A.
Comparative Study on the Intrinsic Rates of Increase of Cyrtobagous singularis and C. salviniae on the Water Weed Salvinia molesta,
W87-09217 4A

SANGALANG, G. B.
Effects of an Acidic River, Caused by Acidic Rain, on Weight Gain, Steroidogenesis, and Reproduction in the Atlantic Salmon (Salmo salar),
W87-08651 5C

SATHYANESAN, A. G.
Lead Nitrate Induced Changes in the Thyroid Physiology of the Catfish Clarias batrachus (L),
W87-08850 5C

SATISH, M. G.
Internal Hydraulics of Diffusers with Uniform Lateral Momentum Distribution,
W87-09366 8B

SATTAUR, O.
Drowning of a Culture,
W87-09231 6G

SAUER, T. J.
Effect of Tillage System on Runoff Losses of Surface-Applied Pesticides,
W87-09001 2E

SAUTER, S.
Measuring Fish Lengths from Instant Photographs Using a Digitizing Tablet and Minicomputer,
W87-08649 7B

SAVENHED, R.
Removal of Individual Off-Flavour Compounds in Water During Artificial Groundwater Recharge and During Treatment by Alum Coagulation/Sand Filtration,
W87-09267 5F

SAVOLAINEN, H.
Ammonia, Hydrogen Sulphide and Methyl Mercaptides in Finnish Municipal Sewage Plants and Pumping Stations,
W87-08725 5D

SAW, C. B.
Applications of Porous Membranes for Biomass Retention in Biological Wastewater Treatment Processes,
W87-08889 5D

SAXENA, R. K.
Estimation of Canopy Reservoir Capacity and Oxygen-18 Fractionation in Throughfall in a Pine Forest,
W87-08814 2B

SAYE, D. J.
Potential for Transduction of Plasmids in a Natural Freshwater Environment: Effect of Plasmid Donor Concentration and a Natural Microbial Community on Transduction in Pseudomonas aeruginosa,
W87-09390 2H

SAYLER, G. S.
Maintenance and Stability of Introduced Genotypes in Groundwater Aquifer Material,
W87-09391 5B

Potential for Transduction of Plasmids in a Natural Freshwater Environment: Effect of Plasmid Donor Concentration and a Natural Microbial Community on Transduction in Pseudomonas aeruginosa,
W87-09390 2H

SCAMEHORN, J. F.
Removal of Multivalent Metal Cations from Water Using Micellular-Enhanced Ultrafiltration,
W87-09223 2K

SCHAFER, C.
Effects of Water Stress on Gas Exchange and Water Relations of Succulent Epiphyte, Kalanchoe Uniflora,
W87-09347 2I

SCHALL, F. R.
Foundation Treatment Using Pneumatically Applied Concrete,
W87-09158 8F

SCHEI, T. A.
Lake Effect on Stream Living Brown Trout (Salmo trutta),
W87-08763 2H

SCHEWE, L. D.
Monitoring Programme for Embankment Dams,
W87-09409 8A

SCHIANNINI, P. C.
Mine and Open Pit Dewatering at Chingola, Zambia,
W87-09584 4B

SCHIMMEL, S. C.
Interlaboratory Comparison of the ASTM Bioconcentration Test Method Using the Eastern Oyster,
W87-08645 5A

SCHINSKY, A.
Inputs of Polychlorinated Biphenyls from the Atmosphere to Lakes Huron and Michigan,
W87-09186 5B

SCHLADOT, J. D.
Environmental Specimen Bank Specific Reference Materials - Main Aims and Preparation,
W87-08918 5A

SCHMIDTKE, N. W.
Introduction to Scale-Up of Water and Wastewater Treatment Processes,
W87-09433 5D

Scale-Up and Scale-Down Concepts and Problems,
W87-09432 5D

SCHMIEDER, A.
Forecasting the Rates of Water Inflowing into Mines,
W87-09599 2F

Water Control Strategy of Mines Under Strong Karstic Water Hazard,
W87-09600 4B

SCHMITT, J. M.
Induction of Crassulacean Acid Metabolism in Mesembryanthemum crystallinum by High Salinity: Mass Increase and de Novo Synthesis of PEP-Carboxylase,
W87-09418 3C

SCHMULBACH, J. C.
Swimming Performance of Fishes Endemic to the Missouri River in South Dakota,
W87-09496 8I

SCHNABEL, R. R.
Elimination of Time Assignment Bias in Estimates of Dispersion Coefficient,
W87-08994 7C

SCHNITZER, M.
Nature of Nitrogen in Humic Substances,
W87-09078 2H

SCHNOOR, J. L.
Modeling Chemical Transport in Lakes, Rivers, and Estuarine Systems,
W87-08672 5B

SCHOENFELD, D. A.
Statistical Analysis,
W87-09284 5C

SCHONEMAN, R. A.
Artificial Ground Water Recharge by Flooding During Grapevine Dormancy,
W87-08979 2F

SCHOTZ, M.
Comparative Study on the Intrinsic Rates of Increase of Cyrtobagous singularis and C. salviniae on the Water Weed Salvinia molesta,
W87-09217 4A

SCHRAMEL, P.
Complete HF Digestion Method for Element and Trace Element Determination in Soils, Sediments, Sludges and Other Similar Samples Using a Closed System (HF-Totalaufschluss im geschlossenen System fur Element- und Spurenelementbestimmungen in Boden, Klarschlamm, Sedimenten u. a. Proben),
W87-08894 5A

Trace and Nutrient Element Transfer from Sewage Sludge-Amended Soil to Crops: A Study on Brassica oleracea,
W87-08917 5B

SCHREIER, H.
Asbestos Fibres Introduce Trace Metals into Streamwater and Sediments,
W87-08912 5B

SCHROEDER, S. A.
Slope Gradient Effect on Erosion of Reshaped Spoil,
W87-09000 2J

SCHROY, J. M.
Environmental Mobility of Dioxins,
W87-08658 5B

Physical/Chemical Properties of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin,
W87-08657 5B

SCHULTZ, L. A.
Containment of Oil Spilled Under Rough Ice,
W87-09526 5B

SCHWEITZER, G. E.
Improved Monitoring Techniques to Assess Groundwater Quality Near Sources of Contamination,
W87-09126 5A

SCIALOM, G.
Tropical Squall Line Observed During the COPT 81 Experiment in West Africa. Part I: Kinematic Structure Inferred from Dual-Doppler Radar Data,
W87-08939 2B

SCOTT, B. C.
Modeling of Atmospheric Wet Deposition,
W87-09165 5B

SCOTT, D. P.
Cadmium Contamination in American Lobster, Homarus americanus, Near a Coastal Lead Smelter: Use of Multiple Linear Regression for Management,
W87-08882 5C

SCOTT, G. I.
Effects of Oil Spills on Mangrove Forests: A Comparison of Five Oil Spill Sites in the Gulf of Mexico and the Caribbean Sea,
W87-09558 5C

SCOTT, H. D.
Air/Soil Exchange Coefficients,
W87-08678 5B

Irrigation Practice for Crop Culture in the Southeastern United States,
W87-09466 3F

SEEGER, D. R.
Disinfectant Chemistry In Drinking Water - Overview of Impacts on Drinking Water Quality,
W87-09122 5F

SEGUIER, J.
Physical and Biological Effects of Gravel Extraction in River Beds,
W87-09049 4C

SEIBER, J. N.
Pesticides in Fog,
W87-09229 5B

SEIDEL, K. M.
Association between Legionella pneumophila and Amoebae in Water,
W87-08906 5F

SEIF, R.
Complete HF Digestion Method for Element and Trace Element Determination in Soils, Sediments, Sludges and Other Similar Samples Using a Closed System (HF-Totalaufschluss im geschlossenen System fur Element- und Spurenelementbestimmungen in Boden, Klarschlamm, Sedimenten u. a. Proben),
W87-08894 5A

SEIP, K. L.
Multiattribute Analysis of the Impact on Society of Phosphorus Abatement Measures,
W87-09013 5G

SELIGMAN, J. D.
Physical and Chemical Behavior and Environmental Acceptability of Stabilized Scrubber Sludge and Fly Ash in Seawater,
W87-09327 5B

SELLGREN, A.
River Flow with Excessive Suspended Sediment Load: An Evaluation of Turbulent Flow Characteristics,
W87-08826 2E

SEN, H. S.
Volatilization Loss of Nitrogen from Submerged Saline Soil,
W87-08892 2G

SERGY, G. A.
BIOS Project - Frontier Oil Spill Countermeasures Research,
W87-09523 5G

SEUX, R.
Kinetics and Mechanisms of Hypochlorite Oxidation of alpha-Amino Acids at the Time of Water Disinfection (Cinetiques et Mechanismes de l'Action Oxydative de l'Hypochlorite sur les Acides alpha-Amines lors de la Desinfection des Eaux),
W87-09274 5F

SEXTRO, R. G.
Understanding the Origin of Radon Indoors--Building a Predictive Capability,
W87-08888 5B

SEYFRIED, P. L.
Comparison of Techniques for Evaluating the Effect of Cadmium on Pseudomas Fluorescens,
W87-08648 5C

SHACKLEY, M. S.
Prehistoric Hunter-Gatherers of South Central Arizona: The Picacho Reservoir Archaic Project,
W87-09191 6G

SHAFER, J. M.
Determining Optimum Pumping Rates for Creation of Hydraulic Barriers to Ground-Water Pollutant Migration,
W87-09108 5G

Reverse Pathline Calculation of Time-Related Capture Zones in Nonuniform Flow,
W87-08753 2F

SHAFER, R. A.
Pumping Performance and Turbidity Generation of Model 600/100 Pneuma Pump: Main Text and Appendixes A and B,
W87-09487 8C

SHANI, U.
Field Method for Estimating Hydraulic Conductivity and Matric Potential-Water Content Relations,
W87-08993 2G

SHAO, Y. J.
Relationship Between Bench Scale and Prototype Activated Sludge Systems,
W87-09449 5D

SHAPIRO, L. J.
Consistent Parameterization of the Effects of Cumulus Clouds on the Large-Scale Momentum and Vorticity Fields,
W87-08938 2B

SHARMA, M. L.
Estimating Evapotranspiration,
W87-09469 2D

SHARMA, P.
Sedimentation and Bioturbation in a Salt Marsh as Revealed by 210Pb, 137Cs, and 7Be Studies,
W87-08932 2L

SHARP, M. S.
Impact of the Esso Bayway Oil Spill on Salt Marsh Macro Fauna,
W87-09550 5C

SHASHKIN, A. V.
Ecological and Statistical Prognosis of the Dynamics of Fish Catch Based on Dendrochronological Data,
W87-08711 2H

SHAUL, G. M.
Acute and Chronic Toxicity to the Fathead Minnow, Pimephales promelas, of Effluents from a Treatment Plant Receiving Dye and Pigment Processing Wastewater,
W87-08656 5C

SHAVIV, A.
Application of Soil Conditioner Solutions to Soil Columns to Increase Water Stability of Aggregates,
W87-09005 2G

SHAW, G. R.
Comparative Kinetics for Bioaccumulation of Polychlorinated Biphenyls by the Polychaete (Capitella capitata) and Fish (Mugil cephalus),
W87-08856 5B

SHAW, R. W.
Canadian Atlantic Storms Program: The Meteorological Field Project,
W87-09255 2B

SHEARER, J. A.
Simultaneous Measurement of Primary Production by Whole-Lake and Bottle Radiocarbon Additions,
W87-08931 2H

SHEDLOCK, R. J.
Hydrology, Water Chemistry and Ecological Relations in the Raised Mound of Cowles Bog,
W87-08837 2H

SHEEHY, J. E.
Nitrogenase Activity, Photosynthesis and Nodule Water Potential in Soyabean Plants Experiencing Water Deprivation,
W87-08798 2I

SHEMEIKKA, P.
Restoration of the River Vaikkojoki, Finland,
W87-09046 2H

SHEN, H. T.
Winter Flow, Ice, and Weather Conditions of the Upper St. Lawrence River, 1971-81; Volume I: Ice Cover Charts (Part A),
W87-09475 2E

SHERIDAN, J. M.
Transport of Solids in Streamflow from Coastal Plain Watersheds,
W87-08924 2J

SHERMAN, R. E.
Comparison of Toxicity Tests Conducted in the Laboratory and in Experimental Ponds using Cadmium and the Fathead Minnow (Pimephales promelas),
W87-09272 5C

SHERR, B. F.
Use of Monodispersed, Fluorescently Labeled Bacteria to Estimate In Situ Protozoan Bacterivory,
W87-09388 2H

SHERR, E. B.
Use of Monodispersed, Fluorescently Labeled Bacteria to Estimate In Situ Protozoan Bacterivory,
W87-09388 2H

SHERWOOD, M.
Impact of Agriculture on Surface Water in Ireland: Part II. Prospects for the Future,
W87-09200 4C

SHIH, M. L.
Determination of Toxic Organophosphorus Compounds by Specific and Nonspecific Detectors,
W87-09220 5A

SHOEMAKER, E. M.
Subglacial Drainage for an Ice Sheet Resting Upon a Layered Deformable Bed,
W87-09248 2F

SHOLJI, I.
Comparison of Backwash Models for Granular Media,
W87-09372 5D

Expansion of Granular Filters During Backwashing,
W87-09371 5D

SHPIRT, E.
Geometric Parameters and Efficiency of Diffused Air Systems,
W87-09437 5D

SHRAM, M.
Irrigation with Brackish Water under Desert Conditions: IV. Salt Tolerance Studies with Lettuce (Lactuca sativa L.),
W87-08746 3C

SHUKLA, J.
Empirical Prediction of the Summer Monsoon Rainfall over India,
W87-08940 2B

SHUTTO, H.
Laboratory Experiment on the Role of Grass for Infiltration and Runoff Processes,
W87-08622 2A

SHUVAL, H.
Seasonal Distribution of Legionellae Isolated from Various Types of Water in Israel,
W87-08903 5A

SHYLIENGER, R. S.
Mine Drainage Problems in Indian Coalfields, with Special Reference to the Problems in Jharia Coalfield,
W87-09571 4C

SICKELS, F. A.
Growth and Survival of Giant Ragweed (Ambrosia trifida L.) in a Delaware River Freshwater Tidal Wetland,
W87-08714 2H

SIEGISMUND, H. R.
Dispersal-Mediated Coexistence of Mud Snails (Hydrobiidae) in an Estuary,
W87-09422 2L

SIEGRIST, R. L.
Soil Clogging During Subsurface Wastewater Infiltration as Affected by Effluent Composition and Loading Rate,
W87-08928 5C

Wastewater-Induced Soil Clogging Development,
W87-09373 5C

SIEVERING, H.
Transport and Dry Deposition of Trace Metals over Southern Lake Michigan,
W87-09179 5B

SIGG, L.
Vertical Transport of Heavy Metals by Settling Particles in Lake Zurich,
W87-08869 5B

SIKORSKI, M. D.
Traveling Trickle Irrigation System,
W87-09465 3F

SILAR, J.
Application of Isotope Techniques and Well Loggind in Investigating Ground Water Influenced by Mining,
W87-09580 2F

SILEO, L.
Embryotoxicity, Teratogenicity, and Aryl Hydrocarbon Hydroxylase Activity in Forster's Terns on Green Bay, Lake Michigan,
W87-08841 5C

SILVERIO, C. M.
Anaerobic Treatment of Distillery Slops Using an Upflow Anaerobic Filter Reactor,
W87-08890 5D

SIMMERS, J. W.
Field Survey of Heavy Metal Uptake by Naturally Occurring Saltwater and Freshwater Marsh Plants,
W87-09490 5B

SIMMONS, M. A.
Information Retrieval System: Impacts of Water-Level Changes on Uses of Federal Storage Reservoirs of the Columbia River; Appendix F: RIVOPR User's Manual,
W87-09477 10B

SIMOLA, O.
Water Level Regulation of Lake Inari: Impacts and Compensation Measures,
W87-09053 2H

SIMON, A.
Man-Induced Gradient Adjustment of the South Fork Forked Deer River, West Tennessee,
W87-09206 6G

SIMONYAN, A. A.
Trophic Interactions in the Plankton of Malyi Sevan in July, 1984,
W87-09219 2H

SIMPSON, P. W.
Manual of Stream Channelization Impacts on Fish and Wildlife,
W87-09497 6G

SIMPSON, R. L.
Growth and Survival of Giant Ragweed (Ambrosia trifida L.) in a Delaware River Freshwater Tidal Wetland,
W87-08714 2H

SIMS, R.
Use of Bog Vegetation as a Monitor of Atmospheric Input of Metals,
W87-09182 5C

SINCLAIR, J. L.
Distribution of Protozoa in Subsurface Sediments of a Pristine Groundwater Study Site in Oklahoma,
W87-09395 2H

SINGH, B.
Rainfall Acidity as Related to Meteorological Parameters in Northern Quebec,
W87-08943 2B

SINGH, B. R.
Mineral Content of Grasses and Grasslands of the Himalayan Region: 2. Concentration of Trace and Major Elements in Grasses in Relation to Soil Properties and Climatic Factors,
W87-09256 2I

SINGH, J.
Water Production Functions for Wheat under Different Environmental Conditions,
W87-08748 3F

SINGH, M.
Improvement of Irrigation Water by Gypsum Beds,
W87-08745 5G

SINGH, N. K.
Hormonal Regulation of Protein Synthesis Associated With Salt Tolerance in Plant Cells,
W87-09227 2I

SINGH, T. P.
Impact of Pesticides on Lipid Metabolism in the Freshwater Catfish, Clarias batrachus, during the Vitellogenic Phase of Its Annual Reproductive Cycle,
W87-08851 5C

Pesticide-Induced Changes in Peripheral Thyroid Hormone Levels during Different Reproductive Phases in Heteropneustes fossilis,
W87-08858 5C

SINGH, V. P.
Stochastic Model for Sediment Yield Using the Principle of Maximum Entropy,
W87-09016 2J

SINHA, S. K.
Irrigation in India: A Physiological and Phenological Approach to Water Management in Grain Crops,
W87-09468 3F

SIRKES, Z.
Surface Manifestations of Internal Oscillations in a Highly Saline Lake (the Dead Sea),
W87-08866 2H

SISTOVARIS, N.
Gas-Chromatographic Determination of Total Polychlorinated Aromates and Chloro-Paraffins Following Catalytic Reduction in the Injection Port,
W87-09260 5A

SITAR, N.
First-Order Reliability Approach to Stochastic Analysis of Subsurface Flow and Contaminant Transport,
W87-09017 5B

SJOVALL, J.
Analysis of Pentachlorophenol in Water and Urine by Enrichment with Lipidex(R) 5000,
W87-08896 5A

SLATTERY, D.
Omaha Recycles Sludge in Agricultural Program,
W87-08808 5E

SLEIGH, J. D.
Outbreak of Legionnaires' Disease in Glasgow Royal Infirmary: Microbiological Aspects,
W87-08703 5C

SLINN, S. A.
Modeling of Atmospheric Particulate Deposition to Natural Waters,
W87-09166 5B

SLINN, W. G. N.
Modeling of Atmospheric Particulate Deposition to Natural Waters,
W87-09166 5B

SMART, P. J.
Plants and Peat Cuttings: Historical Ecology of a Much Exploited Peat land-Thorne Waste. Yorkshire, UK,
W87-09342 4C

SMEDLEY, J. B.
Assessment of Aerial Application of Oil Spill Dispersants,
W87-09533 5G

SMIROV, I. A.
Influence of Sulfur Gas on Water Loss Rate,
W87-08707 2I

SMITH, D. W.
Introduction to Scale-Up of Water and Wastewater Treatment Processes,
W87-09433 5D

SMITH, E. D.
Environmental Impact Analysis of Aquatic Ecosystems Using Rational Threshold Value Methodologies,
W87-09313 5C

SMITH, G. F.
Open Ocean Skimmer Performance Tests,
W87-09562 5G

SMITH, I.
Development of a Simplified Column Test for Evaluation of Thickness of Capping Material Required to Isolate Contaminated Dredged Material,
W87-09091 5G

SMITH, J. A.
Statistical Modeling of Daily Rainfall Occurrences,
W87-09026 7C

SMITH, J. E.
Solute Transport During Absorption and Infiltration: A Comparison of Analytical Approximations,
W87-08990 7C

SMITH, J. H.
Evaluation of Oil Spill Dispersant Testing Requirements,
W87-09508 5G

SMITH, M. A.
Photolytic Ozonation for Protection and Rehabilitation of Ground-Water Resources; A Mechanistic Study,
W87-09092 5G

SMITH, P. D.
BASIC Hydraulics,
W87-09304 8B

SMITH, R. A.
Water-Quality Trends in the Nation's Rivers,
W87-08779 5G

SMITH, S.
Geologic Isolation of High-Level Radioactive Waste: Putting It Away Forever,
W87-08805 5E

SMYTH, M. R.
Electrochemical Analysis of Organic Pollutants,
W87-08612 5A

SMYTH, W. F.
Electrochemical Analysis of Organic Pollutants,
W87-08612 5A

SNORRASON, A.
Transformation of Input to a Stochastic Model Using a Distribution Deterministic Model,
W87-08825 2E

SNYDER, R. P.
Basic Data Report for Drilling and Hydrologic Testing of Drillhole DOE-2 at the Waste Isolation Pilot Plant (WIPP) Site,
W87-09333 5E

SNYDER, W. M.
Irrigation Practice for Crop Culture in the Southeastern United States,
W87-09466 3F

SOBOTHA, E.
Piezometric Level in Fissure Areas (Le Niveau Piezometrique dans les Zones de Diaclases),
W87-09601 2F

SODHI, D. S.
Hydraulic Model Study of Port Huron Ice Control Structure,
W87-09473 2C

SOLDA, M. I.
Role of Cupric Ions in the Generation of Superoxide in Natural Waters,
W87-08716 2K

SORENSEN, D. L.
Potassium Ferrioxalate as Chemical Actinometer in Ultraviolet Reactors,
W87-09377 5F

SOTNIKOVA, L. F.
Determination of Maximum Design Discharges,
W87-09362 2E

SOUTHWORTH, D. C.
Sedimentation in Lake Onalaska, Navigation Pool 7, Upper Mississippi River, Since Impoundment,
W87-08969 2J

SOVERI, J.
Influence of Meltwater on the Amount and Composition of Groundwater in Quaternary Deposits in Finland,
W87-09460 2F

SPACIE, A.
Bioaccumulation,
W87-09296 5B

Role of Electrofishing in Assessing Environmental Quality of the Wabash River,
W87-09328 5A

SPARKS, B. D.
Recovery of Organics from Tailings Pond Sludge Using Coke for Agglomeration,
W87-08602 5D

SPEITEL, G. E.
Biofilm Shearing Under Dynamic Conditions,
W87-09367 5D

SPENCER, M. J.
Seasonal and Spatial Trends in South Greenland Snow Chemistry,
W87-08946 5B

SPILIOTIS, G.
Groundwater Control in Opencast Mining of a Lignite Deposit in Southern Greece,
W87-09583 4B

SPILLER, G. B.
Mathematical Model of Seasonal and Spatial Variation in Phosphorus Concentrations in Lake Memphremagog, Quebec,
W87-08899 5B

SPILLETT, P. B.
Ameliorative Methods to Reinstate Fisheries Following Land Drainage Operations,
W87-09048 6G

SPOLTMAN, R.
Wreck of the Lee Wang Zin,
W87-09528 5G

SPRAGUE, J. B.
Factors that Modify Toxicity,
W87-09285 5C

SPRINGER, C.
Removal of Traces of Pentachlorophenol from Aqueous Acidic Solutions by Solvent Extraction and Solvent Sublation,
W87-08605 5D

SRINIVASAN, K. R.
Role of Hydrogeology in Coal Mining Near Chandrapur in Maharashtra, India,
W87-09569 2F

SRIVASTAVA, N.
Effects of Distillery Waste on the Performance of Cicer arietinum L.,
W87-08873 5C

ST, J. J.
By-Products of Chlorination: Specific Compounds and Their Relationship to Total Organic Halogen,
W87-09123 5F

STACKHOUSE, R. A.
Influence of Cadmium Exposure on Selected Hematological Parameters in Freshwater Teleost, Notemigonus crysoleucas,
W87-08857 5C

STAFFORD, R. T.
Congressional Initiatives,
W87-09133 5G

STALKER, T. W.
Mine and Open Pit Dewatering at Chingola, Zambia,
W87-09584 4B

STATES, S. J.
Survival and Multiplication of Legionella pneumophila in Municipal Drinking Water Systems,
W87-09389 5F

STEELE, K. F.
Orientation Study of St. Francois Mountain and Decaturville Precambrian Areas, Missouri,
W87-09459 2K

Seasonal Effects on Ground-Water Chemistry of the Ouachita Mountains,
W87-09428 2K

STEELINK, C.
Implications of Elemental Characteristics of Humic Substances,
W87-09084 7B

STEELMAN, R. L.
1979 Southern California Dispersant Treated Research Oil Spills,
W87-09536 5G

STEENBERGEN, C. L. M.
Distribution of Particulate Matter in Relation to the Thermal Cycle in Lake Vechten (The Netherlands): The Significance of Transportation Along the Bottom,
W87-09275 2H

STEINBERG, C.
Geochemistry and Ecological Role of Humic Substances in Lakewater,
W87-09071 2H

STEINER, E. J.
Relationship of Low-Level Winds and Moisture to Convection in the Tropical Pacific,
W87-08941 2B

STEINWANDTER, H.
Research in Environmental Pollution: II. Determination of Polychlorinated Nitrobenzenes (PCNB's) in Main River Fish,
W87-08895 5A

STEPHAN, C. E.
Advantages of Using Regression Analysis to Calculate Results of Chronic Toxicity Tests,
W87-08650 5C

STEPHENSON, D. R.
Attenuation of Cd and Pb Solubility in Municipal Waste Incinerator Ash,
W87-08776 5E

STEVENS, A. A.
Disinfectant Chemistry In Drinking Water - Overview of Impacts on Drinking Water Quality,
W87-09122 5F

STEVENSON, F. J.
Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulfur, Micronutrients,
W87-08689 2G

Geochemistry of Soil Humic Substances,
W87-09068 2J

STEWART, R. E.
Canadian Atlantic Storms Program: The Meteorological Field Project,
W87-09255 2B

STEWART, S. M.
Hexavalent Chromium Effects on Carbon Assimilation in Selenastrum capricornutum,
W87-08886 5C

STOBER, J. A.
Carcinogenic Effects in A/J Mice of Particulate of a Coal Tar Paint Used in Potable Water Systems,
W87-08613 5C

STOCKLE, C.
Simulation Model for Predicting Effect of Water Stress on Yield: An Example Using Corn,
W87-09470 3F

STOEPPLER, M.
Environmental Specimen Bank Specific Reference Materials - Main Aims and Preparation,
W87-08918 5A

STOLT, M. H.
Carolina Bays on the Eastern Shore of Maryland: I. Soil Characterization and Classification,
W87-08999 2H

STONE, W. B.
Disposition of Low and High Environmental Concentrations of PCBs in Snapping Turtle Tissues,
W87-09234 5B

STOOKEY, G. K.
Absence of Mutagenic and Antimutagenic Activities of Fluoride in Ames Salmonella Assays,
W87-09405 5C

STORM, P. C.
Limnological Investigations: Lake Koocanusa, Montana; Part 3: Basic Data, Post-Impoundment, 1972-1978,
W87-09463 2H

STRAND, J. W.
Atmospheric Deposition of Particulate Organic Carbon and Polyaromatic Hydrocarbons to Lake Michigan,
W87-09187 5B

STRASKRABA, V.
Development of a Ground Water Hazard Map for an Underground Coal Mine,
W87-09585 2F

STRATTON, G. W.
Toxic Effects of Organic Solvents on the Growth of Blue-Green Algae,
W87-09236 5C

STRAUSS, S. D.
Managing Powerplant Combustion Wastes,
W87-08803 5E

STROES, S.
Acid Neutralizing Capacity of Fine Soil Fractions,
W87-09180 2G

STROOT, P.
Benthic Macroinvertebrates of the Meuse River in Belgium: A Review of Five Years of Research (1980-1984) (Les Macroinvertebres Benthiques de la Meuse Belge: Bilan de Cinq Annees de Recherches (1980 a 1984),
W87-08765 5C

STUART, J.
Induction of Siderophore Activity in Anabaena spp. and Its Moderation of Copper Toxicity,
W87-09386 5G

STUBER, H. A.
Analytical Methodology for Elemental Analysis of Humic Substances,
W87-09083 7B

STUERMER, D. H.
Water-Quality Monitoring at the Hoe Creek Test Site: Review and Preliminary Conclusions,
W87-09495 5B

STUMM, W.
Aquatic Chemistry: An Introduction Emphasizing Chemical Equilibria in Natural Waters,
W87-09340 2A

STURGIS, T. C.
Development of a Simplified Column Test for Evaluation of Thickness of Capping Material Required to Isolate Contaminated Dredged Material,
W87-09091 5G

STURM, M.
Carbon Isotope Fractionation and Changes in the Flux and Composition of Particulate Matter Resulting from Biological Activity during a Sediment Trap Experiment in Lake Greifen, Switzerland,
W87-08867 2H

Vertical Transport of Heavy Metals by Settling Particles in Lake Zurich,
W87-08869 5B

SUBRAMANIAN, V.
Heavy Metals Distribution in the Sediments of Ganges and Brahmaputra Rivers,
W87-09204 5B

SUDAKOV, V. B.
Assignment of Strength Requirments of Concrete for Large Dams,
W87-09354 8F

SUFFET, I. H.
Method for Evaluating the Impact of Radioactivity on Phytoplankton,
W87-09317 5C

SULLIVAN, J. H.
Impact of Trinitrotoluene Wastewaters on Aquatic Biota in Lake Chickamauga, Tennessee,
W87-09322 5C

Statistical Techniques for Evaluating Procedures and Results for Periphyton Sampling,
W87-09319 7C

SULLIVAN, R. C.
Significance of Oxygen Transfer Variables in the Sizing of Dome Diffuser Aeration Equipment,
W87-09438 5D

SULLIVAN, W. M.
Nonpoint Agricultural Pollution: Pesticide Contamination of Groundwater Supplies,
W87-09213 5B

SUZUKI, M.
Movement of Oligotrophic Bacteria in Activated Sludge,
W87-08771 5D

SUZUKI, S.
Chemical Changes of Organic Compounds in Chlorinated Water: XII. Gas Chromatographic-Mass Spectrometric Studies of the Reactions of Methylnaphthalenes with Hypochlorite in Dilute Aqueous Solution,
W87-09224 2K

SWARTZENDRUBER, D.
Quasi-Solution of Richards' Equation for the Downward Infiltration of Water into Soil,
W87-09019 2G

SWIFT, D. R.
Statistical Techniques for Evaluating Procedures and Results for Periphyton Sampling,
W87-09319 7C

SWIFT, R. S.
Fractionation of Soil Humic Substances,
W87-09081 2G

SWISS, J. J.
Kurdistan - An Unusual Spill Successfully Handled,
W87-09527 5G

SYMON, C.
Quantities of Cadmium, Lead, Mercury and Arsenic Entering the U.K. Environment from Human Activities,
W87-08728 5B

SZEFER, K.
Some Metals and Their Possible Sources in Rain Water of the Southern Baltic Coast, 1976 and 1978-1980,
W87-08726 5B

SZEFER, P.
Some Metals and Their Possible Sources in Rain Water of the Southern Baltic Coast, 1976 and 1978-1980,
W87-08726 5B

SZETO, F.
Laboratory Determination of Dispersant Effectiveness: Method Development and Results,
W87-09509 5G

SZEVERENYI, N. M.
Geochemistry of Humin,
W87-09077 2H

TADWALKAR, A. D.
Enhanced Uptake of Phosphorus by Activated Sludge - Effect of Substrate Addition,
W87-09270 5D

TAGUCHI, S.
Spectrophotometric Determination of Traces of Silicon in Water after Collection as Silicomolybdenum Blue on an Organic-Solvent-Soluble Membrane Filter,
W87-08833 5A

TAKAHASHI, I. T.
Brood Size and Neonate Weight of Daphnia magna Produced by Nine Diets,
W87-08641 2H

TAKAHASHI, R.
Movement of Oligotrophic Bacteria in Activated Sludge,
W87-08771 5D

TAKAMI, S.
Changes at Panicle Emergence in the Water Relations of a Wetland and a Dryland Japonica Rice Cultivar Under Wetland Conditions,
W87-09415 2I

TAKEDA, S.
Distribution and Abundance of Helice tridens (De Haan) Burrows and Substratum Conditions in a Northeastern Japan Salt Marsh (Crustacea: Brachyura),
W87-08987 2L

TAKIMOTO, Y.
Comparative Metabolism of Fenitrothion in Aquatic Organisms: I. Metabolism in the Euryhaline Fish, Oryzias latipes and Mugil cephalus,
W87-08859 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: II. Metabolism in the Freshwater Snails, Cipangopaludina japonica and Physa acuta,
W87-08860 5B

Comparative Metabolism of Fenitrothion in Aquatic Organisms: III. Metabolism in the Crustaceans, Daphnia pulex and Palaemon paucidens,
W87-08861 5B

TALBOT, R. J.
Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XII. Growth, Photosynthetic Capacity and Metal Ion Uptake in Salix caprea and S. Cinerea ssp. Oleifolia,
W87-09399 2I

Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XIII. The Effect of Fe(2+) on Photosynthesis and Respiration of Salix caprea and S. cinerea ssp. oleifolia,
W87-09400 2I

TALBOT, V.
Seasonal Variation of Copper and Zinc Concentrations in the Oyster Saccostrea cuccullata from the Dampier Archipelago, Western Australia: Implications for Pollution Monitoring,
W87-08732 5B

TALSMA, T.
Groundwater Recharge and Discharge Response to Rainfall on a Hillslope,
W87-08706 2F

TANAKA, D. L.
Soil Water Evaporation Comparisons Among Tillage Practices in the Northern Great Plains,
W87-09006 2D

TANG, A. J. S.
Analysis of the Impact of the Sudbury Smelters on Wet and Dry Deposition in Ontario,
W87-08942 5B

TANG, W. H.
Overtopping Risk for an Existing Dam,
W87-09461 8A

TANNER, C. E.
Restoration of Oiled Marshes Through Sediment Stripping and Spartina Propagation,
W87-09546 5G

TANOS, A. E.
Meredosia Oil Terminal - The Illinois River Floods a Tank Farm,
W87-09531 5G

TATE, C. H.
Investigation and Discussion of Techniques for Hypolimnion Aeration/Oxygenation,
W87-09481 5G

TAVODA, O.
Influence of Underground Engineering Works on Hydrogeological Conditions of the Suburban Areas,
W87-09581 2F

TAY, F. C. S.
Effect of Waterlogging on Infection of Eucalyptus marginata Seedlings by Phytophthora cinnamomi,
W87-09401 2I

TAYLOR, G. C.
Metropolitan Water Management,
W87-09338 6D

TAYLOR, J. A.
Rainfall in the Wet-Dry Tropics: Extreme Events at Darwin and Similarities Between Years During the Period 1870-1983 Inclusive,
W87-08775 2B

TAYLOR, M. R.
Interactive Computer-Aided Water Resources and Environmental Planning Using Color Raster Graphics: Program Description and User's Guide,
W87-09426 7C

TAYLOR, P.
Knowledge Attitudes and Practices in Relation to Schistosomiasis in a Rural Community,
W87-08778 5F

TAYLOR, S. R.
Comparison of Field and Laboratory Methods for Determining Contaminant Flow Parameters,
W87-08757 5B

TEEPLES, R.
Production Functions for Water Delivery Systems: Analysis and Estimation Using Dual Cost Function and Implicit Price Specifications,
W87-09014 6D

TERAI, R.
Spectrophotometric Determination of Traces of Silicon in Water after Collection as Silicomolybdenum Blue on an Organic-Solvent-Soluble Membrane Filter,
W87-08833 5A

TERLING, G.
Experiences Gained From Deployment of Booms and Skimmers in Various Oil Recovery Applications,
W87-09564 5G

TERLING, O.
Experiences Gained From Deployment of Booms and Skimmers in Various Oil Recovery Applications,
W87-09564 5G

TESMER, M. G.
Annual Macroinvertebrate Sampling - A Low-Cost Tool for Ecological Assessment of Effluent Impact,
W87-09325 5C

TESTUD, J.
Tropical Squall Line Observed During the COPT 81 Experiment in West Africa. Part I: Kinematic Structure Inferred from Dual-Doppler Radar Data,
W87-08939 2B

THALER, J. O.
Modeling for Process Scale-Up of Adsorption and Ion Exchange Systems,
W87-09446 5D

THARP, T. M.
Conditions for Crack Propagation by Frost Wedging,
W87-09350 2C

THEBEAU, L. C.
Mapping the Distribution of Protected and Valuable, Oil-Sensitive Coastal Fish and Wildlife,
W87-09540 7A

Onshore Impacts and Cleanup During the Burmah Agate Oil Spill - November 1979,
W87-09518 5C

THERRIAULT, J.-C.
Resuspension in the Shallow Sublittoral Zone of a Macrotidal Estuarine Environment: Wind Influence,
W87-08933 2L

THEVEAU, L. C.
Effects of the Ixtoc I Oil Spill on the Intertidal and Subtidal Infaunal Populations Along Lower Texas Coast Barrier Island Beaches,
W87-09556 5C

THIBODEAUX, L. J.
Air/Soil Exchange Coefficients,
W87-08678 5B

THOMAS, A. W.
Irrigation Practice for Crop Culture in the Southeastern United States,
W87-09466 3F

THOMAS, B. L.
Toxicity of Chemically Dispersed Oil to Shrimp Exposed to Constant and Decreasing Concentrations in a Flowing System,
W87-09516 5C

THOMAS, H.
Physiological Responses to Drought of Lolium perenne L.: Measurement of, and Genetic Variation in, Water Potential, Solute Potential, Elasticity and Cell Hydration,
W87-08848 2D

THOMAS, J. F.
Application of Laboratory Scale Model Streams Toward Assessing Effluent Impacts in Freshwater Lotic Environments,
W87-09314 5C

THOMPSON, E. P.
Burmah Agate - Chronology and Containment Operations,
W87-09519 5B

THOMPSON, G. A.
Bioaccumulation Potential of Heterotrophic Bacteria for Lead, Selenium, and Arsenic,
W87-09240 5B

THOMPSON, G. P.
By-Products of Chlorination: Specific Compounds and Their Relationship to Total Organic Halogen,
W87-09123 5F

THOMPSON, I. P.
Effect of Polluted and Leached Snow Melt Waters on the Soil Bacterial Community--Quantitative Response,
W87-08874 5C

THOMPSON, J. A. J.
Metal-Binding Protein in the Pacific Oyster, Crassostrea gigas: Assessment of the Protein as a Biochemical Environmental Indicator,
W87-08885 5A

THOMSEN, A.
WATBAL: A Semi-Distributed, Physically Based Hydrological Modelling System,
W87-08823 2G

THORNTON, I.
Hydrological and Chemical Factors Controlling the Concentrations of Fe, Cu, Zn and As in a River System Contaminated by Acid Mine Drainage,
W87-09277 5B

THORNTON, J. D.
Trace Metal and Strong Acid Composition of Rain and Snow in Northern Minnesota,
W87-09178 5B

THORUP, J.
Life Cycles of Four Species of Baetis (Ephemeroptera) in Three Danish Streams,
W87-08764 2H

THRASHER, D.
Design and Use of Pressure Sewer Systems,
W87-09309 5D

THULLEN, J. S.
Biological Control of Aquatic Weeds: The Efficacy of Hybrid Grass Carp in Two Southern California Irrigation Canals,
W87-09480 4A

THURMAN, A. G.
Development of a Ground Water Hazard Map for an Underground Coal Mine,
W87-09585 2F

THURMAN, E. M.
Humic Substances in Groundwater,
W87-09070 2F

TIBBETTS, P. J. C.
Fate and Effects of Dispersant-Treated Compared with Untreated Crude Oil, with Particular Reference to Sheltered Intertidal Sediments,
W87-09537 5G

TIMBURY, M. C.
Outbreak of Legionnaires' Disease in Glasgow Royal Infirmary: Microbiological Aspects,
W87-08703 5C

TLALKA, A.
Low Discharge Periods of Rivers in the Upper Vistula River Basin, Poland,
W87-08970 7B

TLALKA, J.
Low Discharge Periods of Rivers in the Upper Vistula River Basin, Poland,
W87-08970 7B

TOBIANSKY, L.
Seasonality of Legionella Isolates from Environmental Sources,
W87-08902 2H

TOETZ, D.
Lake Loading Ratios (N:P) and Lacustrine Nitrogen Fixation,
W87-08972 2H

TOEWS, D.
Effects of Low Ambient pH on Perivitelline Fluid of Ambystoma maculatum (Shaw) Eggs,
W87-08963 5C

TOKARSKI, E. F.
Evaluating Asphalt Cap Effectiveness at Superfund Site,
W87-09379 5E

TOLLERUD, E. I.
Consistent Parameterization of the Effects of Cumulus Clouds on the Large-Scale Momentum and Vorticity Fields,
W87-08938 2B

TOMISAKI, H.
Separation of Mercury from Aqueous Mercuric Chloride Solutions by Onion Skins,
W87-08606 5D

TONER, P. F.
Impact of Agriculture on Surface Water in Ireland: Part I. General,
W87-09199 5B

TONKIKH, A. P.
Qualitative Model of Eutrophication in Macrophyte Lakes,
W87-08785 2H

TOPP, G. C.
Time-Domain Reflectometry (TDR) and Its Application to Irrigation Scheduling,
W87-09467 3F

TOPPING, B.
Biodegradability of para-Dichlorobenzene and Its Behaviour in Model Activated Sludge Plants,
W87-09269 5D

TORGRIMSON, G. M.
Comprehensive Model for Oil Spill Simulation,
W87-09552 5B

TORNO, H. C.
Example Model Applications,
W87-09105 4C

TOUSSAINT, D.
Gas Chromatographic Analysis of Volatile Compounds in Water and Biological Samples with an Automatic Injector,
W87-09012 7B

TRANTER, M.
Spatial Variability in the Chemical Composition of Snowcover in a Small, Remote, Scottish Catchment,
W87-08945 5B

TRAUTH, K. M.
Water Resources Audit for Small Communities,
W87-08953 5F

TREW, R. M.
Presence of Legionella in London's Water Supplies,
W87-08901 5F

TRILLA ARRUFAT, J.
Origin and Dynamics of the Waters Flowing into the Mining Works in Reocin (Santander, Spain) (Sobre el Origen y Dinamica de las Aguas Fluyentes a las Explotaciones Mineras de Reocin (Santander, Espana)),
W87-09586 2F

TRIM, A. H.
Acute Toxicity of Emulsifiable Concentrations of Three Insecticides Commonly Found in Nonpoint Source Runoff into Estuarine Waters to the Mummichog, Fundulus heteroclitus,
W87-08881 5C

TRIPOLI, G. J.
Numerical Simulation of the Effects of Varying Ice Crystal Nucleation Rates and Aggregation Processes on Orographic Snowfall,
W87-08697 2B

TROUTMAN, B. M.
Use of Topological Information in Hydrograph Estimation,
W87-08976 2E

TRUSTRUM, N. A.
Effect of Soil Slip Erosion on Wairoa Hill Pasture Production and Composition,
W87-08734 2J

TSANG, C.-F.
Groundwater Transport: Handbook of Mathematical Models,
W87-09306 5B

TSAY, R. S.
Scavenging of Atmospheric Sulfate by Arctic Snow,
W87-08947 2C

TSUDA, T.
Movement of Oligotrophic Bacteria in Activated Sludge,
W87-08771 5D

TULLOCH, D.
Rainfall in the Wet-Dry Tropics: Extreme Events at Darwin and Similarities Between Years During the Period 1870-1983 Inclusive,
W87-08775 2B

TUNINK, D. H.
Swimming Performance of Fishes Endemic to the Missouri River in South Dakota,
W87-09496 8I

TUNNELL, J. W.
Effects of the Ixtoc I Oil Spill on the Intertidal and Subtidal Infaunal Populations Along Lower Texas Coast Barrier Island Beaches,
W87-09556 5C

TURCANT, A.
Gas Chromatographic Analysis of Volatile Compounds in Water and Biological Samples with an Automatic Injector,
W87-09012 7B

TURNER, N. C.
Changes at Panicle Emergence in the Water Relations of a Wetland and a Dryland Japonica Rice Cultivar Under Wetland Conditions,
W87-09415 2I

TUTTLE, J. H.
Microbially Mediated Leaching of Low-Sulfur Coal in Experimental Coal Columns,
W87-09393 5B

TVEDE, A. M.
Temperature and Flow Conditions in a Reservoir with a Submerged Outlet Tunnel During the Winter Period,
W87-08828 2H

TWERSKY, M.
Irrigation with Brackish Water under Desert Conditions: V. Nitrogen Requirement of Toma-

TWERSKY, M.

toes (Lycopersicon esculentum Mill.) during Germination under Drip Irrigation,
W87-08747 3C

TWICKLER, M. S.
Seasonal and Spatial Trends in South Greenland Snow Chemistry,
W87-08946 5B

UDEVITZ, M. S.
Prediction of the Occurrence of Four Species of Mosquito Larvae with Logistic Regression on Water-Chemistry Variables,
W87-08846 2H

UHLIG, G.
Closed-Loop System for Generating Ozone from Oxygen and Its Application to the Treatment of Drinking Water at Duisburg, Federal Republic of Germany,
W87-09143 5F

ULRICH, B.
Dynamics of Sulfate Retention by Acid Forest Soils in an Acidic Deposition Environment,
W87-09008 5B

UMORIN, P. P.
Interrelationships of Algae and Bacteria During Methane Oxidation,
W87-08712 2H

UPADHYA, Y. D.
Removal of Phenols by Adsorption on Fly Ash,
W87-09250 5D

UPADHYAY, S. N.
Removal of Phenols by Adsorption on Fly Ash,
W87-09250 5D

URBAN, L. V.
Water Resources Audit for Small Communities,
W87-08953 5F

UTHE, J. F.
Cadmium Contamination in American Lobster, Homarus americanus, Near a Coastal Lead Smelter: Use of Multiple Linear Regression for Management,
W87-08882 5C

VAGANOV, E. A.
Ecological and Statistical Prognosis of the Dynamics of Fish Catch Based on Dendrochronological Data,
W87-08711 2H

VALSARAJ, K. T.
Removal of Traces of Pentachlorophenol from Aqueous Acidic Solutions by Solvent Extraction and Solvent Sublation,
W87-08605 5D

VAN BRUGGEN, A. H. C.
Effects of Simulated Acidic Mist on Germination of Alternaria solani and Phytophthora infestans in vitro and their Infection Efficiency and Sporulation on Potato,
W87-09414 5C

VAN DE WALLE, E.
Comparative Effects of Mine Wastes on the Benthos of an Acid and an Alkaline Pond,
W87-08962 5C

VAN DER WEIJDEN, C. H.
Geochemical Studies in the Drainage Basin of the Rio Vouga, Portugal. IV. Impact of Land Use on the Hydrogeochemistry of Natural Waters in the Vouzela Region,
W87-09207 4C

VAN DRIMMELEN, N. J.
Design Aspects of the First 'Slicktrail' Dredger, The Cosmos,
W87-09566 5G

VAN GRIEKEN, R.
Heavy Metals Distribution in the Sediments of Ganges and Brahmaputra Rivers,
W87-09204 5B

VAN HASSEL, J. H.
Factors Influencing Acute Toxicity of Coal Ash to Rainbow Trout (Salmo gairdneri) and Bluegill Sunfish (Lepomis macrochirus),
W87-08978 5C

VAN ROOY, D.
Stochastic Modelling of a Contaminated Aquifer: The Unconditional Approach,
W87-08820 5B

VAN STADEN, J. F.
On-Line Sulphate Monitoring by Reversed Flow Injection Analysis and Alternating Reagent Injection,
W87-09261 5A

VAN'T DACK, L.
Heavy Metals Distribution in the Sediments of Ganges and Brahmaputra Rivers,
W87-09204 5B

VANCE, B. D.
Hexavalent Chromium Effects on Carbon Assimilation in Selenastrum capricornutum,
W87-08886 5C

VANDENBROUCKE, M.
Geochemistry of Humic Substances in Marine Sediments,
W87-09076 2J

VANDERMEULEN, J. H.
Geomorphological Alteration of a Heavily Oiled Saltmarsh (Ile Grande, France) as a Result of Massive Cleanup,
W87-09543 5B

VANDUSEN, J. D.
Factors Affecting Water and Wastewater Rates,
W87-09221 6C

VANNI, M. J.
Effects of Food Availability and Fish Predation on a Zooplankton Community,
W87-08799 2H

VANNIEKERK, A. M.
Relationship Between Bench Scale and Prototype Activated Sludge Systems,
W87-09449 5D

VANT, W. N.
Absorption of Light by Yellow Substance in Freshwater Lakes,
W87-08934 2H

VARANKA, I.
Effect of Mosquito Killer Insecticides on Freshwater Mussels,
W87-08908 5C

VARGHESE, P. T.
Influence of Long Term Cultural Operations on Physical and Water Retention Characters of a Red Sandy Loam Soil,
W87-08773 2G

VAZQUEZ-MORENO, L.
Induction of Crassulacean Acid Metabolism in Mesembryanthemum crystallinum by High Salinity: Mass Increase and de Novo Synthesis of PEP-Carboxylase,
W87-09418 3C

VEHVILAINEN, B.
Operational Spring Time Forecasting Difficulties and Improvements,
W87-08824 2E

VELILLA, J. L.
Special Techniques of Ground Treatment in Mining Works (Las Tecnicas Especiales de Tratamiento del Terreno en los Trabajos de Mineria),
W87-09598 4B

VELZ, C. J.
Applied Stream Sanitation,
W87-09189 2H

VENANT, A.
Contamination of Fish from the French Zone of Lake Leman by Organochlorine Compounds between 1973 and 1981 (Contamination des Poissons du Secteur Francais du Lac Leman, par les Composes Organochlores entre 1973 et 1981),
W87-08909 2H

VERDINA, A.
Xenobiotic-Metabolizing Enzyme Systems in Test Fish: I. Comparative Studies of Liver Microsomal Monooxygenases,
W87-08852 5C

VERDOUW, H.
Distribution of Particulate Matter in Relation to the Thermal Cycle in Lake Vechten (The Netherlands): The Significance of Transportation Along the Bottom,
W87-09275 2H

VESILIND, P. A.
Scale-Up of Solid Bowl Centrifuges for Sludge Dewatering,
W87-09445 5E

VIEILLY, C.
Epidemiological Evidence of Legionellosis Transmission through Domestic Hot Water Supply Systems and Possibilities of Control,
W87-08905 5F

VIGNESWARAN, S.
Importance of Laboratory Scale Study for the Design of Mobile-Bed Filter,
W87-09442 5F

VINCENT, W. F.
Photosynthate Distribution by Microplankton in Permanently Ice-Covered Antarctic Desert Lakes,
W87-08872 2H

VITTOZZI, L.
Xenobiotic-Metabolizing Enzyme Systems in Test Fish: I. Comparative Studies of Liver Microsomal Monooxygenases,
W87-08852 5C

VODICNIK, M. J.
Biotransformation,
W87-09297 5B

VOINOV, A. A.
Qualitative Model of Eutrophication in Macrophyte Lakes,
W87-08785 2H

VOULGAROPOULOS, A.
Correlation of Some Organic Pollution Factors in Water Systems in Northern Greece,
W87-09264 5B

VOWELL, J. L.
Digital Controller for Discrete Stage Activation of Automatic Pumping Samplers,
W87-08983 7B

VRIEND, S. P.
Geochemical Studies in the Drainage Basin of the Rio Vouga, Portugal. IV. Impact of Land Use on the Hydrogeochemistry of Natural Waters in the Vouzela Region,
W87-09207 4C

VYSOTSKAYA, L. G.
Ecological and Statistical Prognosis of the Dynamics of Fish Catch Based on Dendrochronological Data,
W87-08711 2H

WALDREN, S.
Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XI. Growth of Geum rivale L. and Geum urbanum L. and Soil Chemical Condition in Experimentally Flooded Soil,
W87-09398 2I

WALKER, C.
Innovative State Policies for Aiding Community Water Suppliers,
W87-08951 5F

WALKER, C. H.
Kinetic Models for Predicting Bioaccumulation of Pollutants in Ecosystems,
W87-09247 5B

WALKER, S. L.
Suspended Particulate Matter in Commencement Bay,
W87-09498 2J

WANG, F. T.
Water-Quality Monitoring at the Hoe Creek Test Site: Review and Preliminary Conclusions,
W87-09495 5B

WANG, H. F.
Introduction to Groundwater Modeling: Finite Difference and Finite Element Methods,
W87-08684 2F

WANG, M. P.
Acute Toxicity of Chlorine on Freshwater Organisms: Time-Concentration Relationships of Constant and Intermittent Exposures,
W87-08640 5C

WANGEN, L. E.
Leaching Behaviors of Low-Sulfur Coals and Coal Wastes from Three Western Coal Preparation Plants,
W87-09429 5B

WARD, S.
Metal-Binding Protein in the Pacific Oyster, Crassostrea gigas: Assessment of the Protein as a Biochemical Environmental Indicator,
W87-08885 5A

WARNER, J. P.
Spring and Summer Movements of Subadult Striped Bass, Morone saxatilis, in the Connecticut River,
W87-09253 2H

WARRICK, A. W.
Bare Soil Evaporation Near a Surface Point-Source Emitter,
W87-08743 2D

Determination of Hydraulic Conductivity from Auger Holes and Pits - An Approximation,
W87-08617 2F

WATKINS, D.
Scale-Up Experience with the Waterloo SCP Process in Industrial Biomass Waste Treatment,
W87-09455 5D

WATLING, R. J.
Bioaccumulation Potential of Heterotrophic Bacteria for Lead, Selenium, and Arsenic,
W87-09240 5B

WATSON, C. F.
Influence of Cadmium Exposure on Selected Hematological Parameters in Freshwater Teleost, Notemigonus crysoleucas,
W87-08857 5C

WATSON, K. K.
Gravity Drainage Analysis for Scale Heterogeneous Porous Materials Under Falling Water Table Conditions,
W87-09020 2G

WEATHERS, K. C.
Two New Ground-Level Cloud Water Sampler Designs Which Reduce Rain Contamination,
W87-08948 7B

WEBER, C. I.
Comparison of the Hydrophobic-Grid Membrane Filter Procedure and Standard Methods for Coliform Analysis of Water,
W87-09392 5A

Effects of Copper on the Periphyton of a Small Calcareous Stream,
W87-09318 5C

Effects of Exposure Time, Season, Substrate Type, and Planktonic Populations on the Taxonomic Composition of Algal Periphyton on Artificial Substrates in the Ohio and Little Miami Rivers, Ohio,
W87-09321 5C

Evaluation of the Effects of Effluents on Aquatic Life in Receiving Waters - An Overview,
W87-09312 5C

WEBER, J. H.
Adsorptive Behavior of Butyltin Compounds Under Simulated Estuarine Conditions,
W87-08730 5B

WEBER, W. J.
Modeling for Process Scale-Up of Adsorption and Ion Exchange Systems,
W87-09446 5D

WEBSTER, G. R. B.
Bioconcentration of Four Chlorinated Dioxins by Rainbow Trout and Fathead Minnows,
W87-08659 5B

WEERASOORIYA, S. V. R.
Heavy Metal Pollution of the Mid-Canal of Kandy: An Environmental Case Study from Sri Lanka,
W87-08840 5C

WEFRING, D. R.
Annual Macroinvertebrate Sampling - A Low-Cost Tool for Ecological Assessment of Effluent Impact,
W87-09325 5C

WEIDER, L. J.
Ecological and Physiological Differentiation Among Low-Arctic Clones of Daphnia Pulex,
W87-08691 2H

WEINSTEIN, L. H.
Effect of Fertilization with Municipal Sludge on the Glutathione, Polyamine, and Cadmium Content of Cole Crops and Associated Loopers (Trichoplusia ni),
W87-08835 5C

WEISSENHORN, F. J.
Removal of Iron and Manganese by Ozone during Drinking Water Treatment in Dusseldorf,
W87-09136 5F

WEITZEL, R. L.
Assessment of Effluent Impacts through Evaluation of Periphyton Diatom Community Structure,
W87-09320 5C

WELLS, N. A.
Shifting of the Kosi River, Northern India,
W87-08834 2E

WENSTOP, F.
Multiattribute Analysis of the Impact on Society of Phosphorus Abatement Measures,
W87-09013 5G

WENZEL, H. G.
Rainfall for Urban Stormwater Design,
W87-09098 2B

WERK, K. S.
Field Water Relations of a Compass Plant, Lactuca serriola L.,
W87-08772 2I

WERSHAW, R. L.
Application of Nuclear Magnetic Resonance Spectroscopy for Determining Functionality in Humic Substances,
W87-09088 7B

Molecular Size and Weight Measurements of Humic Substances,
W87-09085 7B

WESTERMAN, P. W.
Swine Lagoon Effluent Applied to Coastal Bermudagrass,
W87-09472 5D

Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: I. Persistence, Yield, Quality, and Elemental Removal,
W87-08919 5C

Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: II. Rainfall Runoff and Soil Chemical Properties,
W87-08920 5C

WESTMAN, K.
Effects of Habitat Modification on Freshwater Crayfish,
W87-09062 4C

WETTLAUFER, S. H.
Effect of Fertilization with Municipal Sludge on the Glutathione, Polyamine, and Cadmium Content of Cole Crops and Associated Loopers (Trichoplusia ni),
W87-08835 5C

WHEELER, B. D.
Plants and Peat Cuttings: Historical Ecology of a Much Exploited Peat land-Thorne Waste. Yorkshire, UK,
W87-09342 4C

WHITE, E. M.
Spring Wheat Growth at High and Low Soil Water with Constricted Upper Roots,
W87-08893 2D

WHITE, G. C.
Handbook of Chlorination,
W87-09064 5D

WHITEHOUSE, B.
Biodegration of Chemically Dispersed Crude Oil,
W87-09512 5B

WICKHAM, P.
Comparative Effects of Mine Wastes on the Benthos of an Acid and an Alkaline Pond,
W87-08962 5C

WIEGAND, R. C.
Internal Waves of the Second Vertical Mode in a Stratified Lake,
W87-08863 2H

WIESNER, M. R.
Optimal Water Treatment Plant Design,
W87-09374 5F

WIGILIUS, B.
Systematic Approach to Adsorption on XAD-2 Resin for the Concentration and Analysis of Trace Organics in Water Below the (mu)g/l Level,
W87-09011 5A

WILCOX, D. A.
Hydrology, Water Chemistry and Ecological Relations in the Raised Mound of Cowles Bog,
W87-08837 2H

WILLIAMS, G. D.
Yakima River Basin Historical Resource Survey, Volume I: Overview and Management Recommendations,
W87-09192 6G

WILLIAMS, L. R.
Harmonization of Biological Testing Methodology: A Performance-Based Approach,
W87-08646 5A

WILLIAMS, R. M.
Exchange of Particles and Gases Across Water Surfaces,
W87-09168 5B

WILLIAMS, U. P.
Feeding Reduction and Recovery in Cunner Tautogolabrus adspersus Following Exposure to Crude Oil,
W87-09239 5C

WILLIAMSON, W. H.
Hydrogeological Aspects of Coal Mining Under Stored Waters Near Sydney, Australia,
W87-09587 2F

WILLIS, A. J.
Plants and Peat Cuttings: Historical Ecology of a Much Exploited Peat land-Thorne Waste. Yorkshire, UK,
W87-09342 4C

WILSON, D. J.
Removal of Antimony from Aqueous Systems,
W87-08604 5F

WILSON, H. B.
Development and Testing of a Weir Boom for Oil Recovery at Sea,
W87-09563 5G

WILSON, J. T.
Maintenance and Stability of Introduced Genotypes in Groundwater Aquifer Material,
W87-09391 5B

WILSON, L. J.
Water Treatment: The States Zero in on Groundwater Regulation,
W87-09222 5F

WINTER, K.
Induction of Crassulacean Acid Metabolism in Mesembryanthemum crystallinum by High Salinity: Mass Increase and de Novo Synthesis of PEP-Carboxylase,
W87-09418 3C

WINTON, J. M.
Water Treatment: The States Zero in on Groundwater Regulation,
W87-09222 5F

WISE, P. L.
Clean Water Act Update: A New Role for Toxicology,
W87-08627 6E

WLOSINSKI, J. H.
Evaluation of the Model CE-QUAL-R1 for Use by the Aquatic Plant Control Research Program,
W87-09486 5B

WOLFE, M. H.
Chemistry of Tension Lysimeter Water and Lateral Flow in Spruce and Hardwood Stands,
W87-08926 5B

WOLFORD, A. M.
Contamination of Groundwater by Hydrocarbons from a Refinery - A Case History,
W87-09547 5G

WOLMAN, M. G.
Water-Quality Trends in the Nation's Rivers,
W87-08779 5G

WOLMARANS, J. F.
Water Hazard in Deep Gold Mining of the Far West Witwatersrand - South Africa,
W87-09588 2F

WONG, C. S.
Biodegration of Chemically Dispersed Crude Oil,
W87-09512 5B

WONG, K.-F. V.
Predictive Application of an ORNL Geohydrology Model,
W87-08760 7C

WOODIN, S. J.
Fate of Some Components of Acidic Deposition in Ombrotrophic Mires,
W87-09382 5B

WOODS, E. G.
Ixtoc I Oil Spill - The Damage Assessment Program and Ecological Impact,
W87-09554 5C

WOODS, P. H.
Leaching Losses from Irrigated Pasture: Waiau Irrigation Scheme, North Canterbury,
W87-08737 5B

WORKMAN, S. M.
Ammonium Bicarbonate-DTPA and DTPA Extractions of Sludge-Amended Soils,
W87-08923 5A

WU, P.-I.
Economic Differences Between Cumulative and Episodic Reduction of Sediment from Cropland,
W87-09090 2J

WUDIRI, B. B.
Effects of Water Stress on Flowering and Fruit Set in Processing-Tomatoes,
W87-08770 2I

YADAV, A. K.
Pesticide-Induced Changes in Peripheral Thyroid Hormone Levels during Different Reproductive Phases in Heteropneustes fossilis,
W87-08858 5C

YADAV, R. C.
New Method for Lining of Field Irrigation Channels,
W87-08750 3F

YAMADA, H.
Suppression of Phosphate Liberation from Sediment by Using Iron Slag,
W87-09273 5G

YAMADA, K.
Influence of Simulated Acidic Rain on Vegetative and Reproductive Tissues of Cucumber (Cucumis sativus L.),
W87-09232 5C

YAMAMOTO, F.
Effects of Flooding, Tilting of Stems, and Ethrel Application on Growth, Stem Anatomy and Ethylene Production of Pinus Densiflora Seedlings,
W87-08797 2I

YAMAMOTO, Y.
Isolation of Mutagenic Components by High-Performance Liquid Chromatography from XAD Extract of Water from the Nishitakase River, Kyoto City, Japan,
W87-08723 5A

YAMANAKA, S.
Isolation of Mutagenic Components by High-Performance Liquid Chromatography from XAD Extract of Water from the Nishitakase River, Kyoto City, Japan,
W87-08723 5A

YAP, D.
Analysis of the Impact of the Sudbury Smelters on Wet and Dry Deposition in Ontario,
W87-08942 5B

YAPIJAKIS, C.
Unique Pre-Ozonation - D.E. Filtration Water Treatment Plant Design is Based on Pilot Plant Data,
W87-09443 5F

YARECHEWSKI, A. L.
Bioconcentration of Four Chlorinated Dioxins by Rainbow Trout and Fathead Minnows,
W87-08659 5B

YEE, H. S.
Selenium in the Tributaries of the Orinoco in Venezuela,
W87-09406 2K

YEH, G. T.
Predictive Application of an ORNL Geohydrology Model,
W87-08760 7C

YEN, B. C.
Overtopping Risk for an Existing Dam,
W87-09461 8A

YONEYAMA, H.
Movement of Oligotrophic Bacteria in Activated Sludge,
W87-08771 5D

YONGE, D. R.
Metal Precipitation in Two Landfill Leachates,
W87-09368 5G

YOUNG, H. N.
Surveillance, Tracking, and Model Correlation of the Spill from the Tanker Burmah Agate,
W87-09520 7B

YUEN, A. T. K.
Transfer Rates of Gaseous Pollutants Between the Atmosphere and Natural Waters,
W87-09167 5B

ZAKHAROV, V. N.
Programmed Closing of Gates Upon Loss of Drive by a Pump Unit,
W87-09355 8C

ZALESSKII, F. V.
Determination of Maximum Design Discharges,
W87-09362 2E

ZALEWSKI, M.
Regulation of Riverine Fish Communities by a Continuum of Abiotic-Biotic Factors,
W87-09037 2H

ZASLAVSKY, D.
Application of Soil Conditioner Solutions to Soil Columns to Increase Water Stability of Aggregates,
W87-09005 2G

ZAYED, S. M. A. D.
Fate of 14C-Lindane in a Rice-Fish Model Ecosystem,
W87-08915 5B

ZELLWEGER, G. W.
Evaluation of Natural Tracers in an Acidic and Metal-Rich Stream,
W87-09021 7B

ZHANG, R.
Determination of Hydraulic Conductivity from Auger Holes and Pits - An Approximation,
W87-08617 2F

ZIBILSKE, L. M.
Dynamics of Nitrogen and Carbon in Soil during Papermill Sludge Decomposition,
W87-08891 5E

ZIEGLER, H.
Water Vapor Uptake and Photosynthesis of Lichens: Performance Differences in Species with Green and Blue-Green Algae as Phycobionts,
W87-09345 2I

ZIKA, R. G.
Free Amino Acids in Marine Rains: Evidence for Oxidation and Potential Role in Nitrogen Cycling,
W87-09349 2B

ZIMMERMAN, R. J.
Fish Predation on Juvenile Brown Shrimp, Penaeus Aztecus Ives: Effects of Turbidity and Substratum on Predation Rates,
W87-09252 2H

ZITTEL, A. E.
Swimming Performance of Fishes Endemic to the Missouri River in South Dakota,
W87-09496 8I

ZOHAR, Y.
Irrigation with Brackish Water under Desert Conditions: V. Nitrogen Requirement of Tomatoes (Lycopersicon esculentum Mill.) during Germination under Drip Irrigation,
W87-08747 3C

ZOPPINI, A.
Xenobiotic-Metabolizing Enzyme Systems in Test Fish: I. Comparative Studies of Liver Microsomal Monooxygenases,
W87-08852 5C

ZSURGER, N.
Statistical Assessment of a Sampling Pattern for Evaluation of Changes in Mercury and Zinc Concentrations in Patella coerulea,
W87-08884 5A

ZUZEL, J. F.
Point Probability Distributions of Frozen Soil,
W87-08696 2C

ZWACK, P.
Rainfall Acidity as Related to Meteorological Parameters in Northern Quebec,
W87-08943 2B

ORGANIZATIONAL INDEX

ACADEMIA SINICA, LUOJIASHAN (CHINA). INSTITUTE OF HYDROBIOLOGY.
Quantitative and Qualitative Aspects of Fish Crop in Relation to Environmental Quality,
W87-08855 5C

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, BENEDICT, MD. BENEDICT ESTUARINE RESEARCH LAB.
Power-Plant-Related Estuarine Zooplankton Studies,
W87-09316 5C

ACADEMY OF SCIENCES, MOSCOW (USSR). LAB. OF MATHEMATICAL ECOLOGY.
Qualitative Model of Eutrophication in Macrophyte Lakes,
W87-08785 2H

ACADIA UNIV., WOLFVILLE, (NOVA SCOTIA). DEPT. OF BIOLOGY.
Effects of Low Ambient pH on Perivitelline Fluid of Ambystoma maculatum (Shaw) Eggs,
W87-08963 5C

AGRAR-UND HYDROTECHNIK, ESSEN (GERMANY, F.R.).
Proposals for Agricultural Development of Wadi Dhuleil Catchment, Jordan,
W87-08739 3F

AGRICULTURAL RESEARCH ORGANIZATION, BET-DAGAN (ISRAEL). VOLCANI CENTER.
Effect of Sewage Sludge on Soil Structural Stability: Microbiological Aspects,
W87-08997 5C

AGRICULTURAL RESEARCH SERVICE, BELTSVILLE, MD. HYDROLOGY LAB.
Temporal Observations of Surface Soil Moisture Using A Passive Microwave Sensor,
W87-08781 2G

Pulsed Nuclear Magnetic Resonance Instrument for Soil-Water Content Measurement: Sensor Configurations,
W87-08991 7B

AGRICULTURAL RESEARCH SERVICE, BELTSVILLE, MD. PLANT PHOTOBIOLOGY LAB.
Responses of Gas Exchange to Humidity in Populations of Three Herbs from Environments Differing in Atmospheric Water,
W87-09346 2I

AGRICULTURAL RESEARCH SERVICE, FRESNO, CA. WATER MANAGEMENT RESEARCH LAB.
Water Quality Beneath Urban Runoff Water Management Basins,
W87-08967 2F

Traveling Trickle Irrigation System,
W87-09465 3F

AGRICULTURAL RESEARCH SERVICE, LUBBOCK, TX. PLANT AND WATER CONSERVATION RESEARCH UNIT.
Use of Canopy Temperatures to Identify Water Conservation in Cotton Germplasm,
W87-08788 3F

AGRICULTURAL RESEARCH SERVICE, PENDLETON, OR. COLUMBIA PLATEAU CONSERVATION RESEARCH CENTER.
Point Probability Distributions of Frozen Soil,
W87-08696 2C

AGRICULTURAL RESEARCH SERVICE, PROSSER, WA.
Control of Furrow Erosion With Crop Residues and Surge Flow Irrigation,
W87-09003 3F

AGRICULTURAL RESEARCH SERVICE, RALEIGH, NC. DEPT. OF AGRICULTURAL AND BIOLOGICAL ENGINEERING.
Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: II. Rainfall Runoff and Soil Chemical Properties,
W87-08920 5C

AGRICULTURAL RESEARCH SERVICE, RALEIGH, NC. DEPT. OF CROP SCIENCE AND ANIMAL SCIENCE.
Swine Manure and Lagoon Effluent Applied to a Temperate Forage Mixture: I. Persistence, Yield, Quality, and Elemental Removal,
W87-08919 5C

AGRICULTURAL RESEARCH SERVICE, SIDNEY, MT.
Soil Water Evaporation Comparisons Among Tillage Practices in the Northern Great Plains,
W87-09006 2D

AGRICULTURAL RESEARCH SERVICE, TIFTON, GA. SOUTHEAST WATERSHED RESEARCH CENTER.
Transport of Solids in Streamflow from Coastal Plain Watersheds,
W87-08924 2J

AGRICULTURAL RESEARCH SERVICE, WATKINSVILLE, GA.
Irrigation Practice for Crop Culture in the Southeastern United States,
W87-09466 3F

AGRICULTURAL UNIV. OF NORWAY, AAS.
Profiles of Nitrogen Species in a Sand-Silt Aquifer at Haslemoen, Solor, South Norway,
W87-08818 5B

AGRICULTURAL UNIV., WAGENINGEN (NETHERLANDS). DEPT. OF WATER POLLUTION CONTROL.
Methanogenic Toxicity and Anaerobic Degradability of a Hydrolyzable Tannin,
W87-09278 5D

AHMADU BELLO UNIV., ZARIA (NIGERIA). DEPT. OF AGRICULTURAL ENGINEERING.
New Method for Lining of Field Irrigation Channels,
W87-08750 3F

AHMADU BELLO UNIV., ZARIA (NIGERIA). DEPT. OF SOIL SCIENCE.
Physical Changes Induced by Rainfall in the Surface Layer of an Alfisol, Northern Nigeria,
W87-09214 2G

AHMADU BELLO UNIV., ZARIA (NIGERIA). DEPT. OF VETERINARY PUBLIC HEALTH AND PREVENTIVE MEDICINE.
Public Health Significance of Industrial Pollution in Zaria, Nigeria,
W87-09226 5B

AKADEMIYA NAUK SSSR, LENINGRAD. ZOOLOGICAL INST.
Trophic Interactions in the Plankton of Malyi Sevan in July, 1984,
W87-09219 2H

ALASKA STATE DEPT. OF ENVIRONMENTAL CONSERVATION, JUNEAU.
Wreck of the Lee Wang Zin,
W87-09528 5G

ALASKA UNIV., JUNEAU. SCHOOL OF FISHERIES AND SCIENCE.
Histopathology,
W87-09290 5C

ALBERTA ENVIRONMENT, EDMONTON.
Predicting Settlement at a Damsite on a Tunnel Valley Deposit in Alberta,
W87-08795 8A

ALBERTA UNIV., EDMONTON. DEPT. OF CIVIL ENGINEERING.
Scale-Up of a Radium-226 Removal Process,
W87-09448 5D

ALEXANDRIA UNIV. (EGYPT). COLL. OF AGRICULTURE.
Estimating Water Table Contribution to the Water Supply of Maize,
W87-08740 3F

ALEXIS CARREL FACULTY OF MEDICINE, LYON (FRANCE). NATIONAL HEALTH LAB.
Epidemiological Evidence of Legionellosis Transmission through Domestic Hot Water Supply Systems and Possibilities of Control,
W87-08905 5F

AMERICAN ARCHAEOLOGICAL CONSULTANTS, INC. FAIR OAKS, CA.
Prehistoric Cultural Resources Study Predictive Model and Field Survey Weber Basin Project,
W87-09335 6G

AMERICAN ELECTRIC POWER SERVICE CORP., COLUMBUS, OH. ENVIRONMENTAL ENGINEERING DIV.
New Approach for Regulating Iron in Water Quality Standards,
W87-08636 5G

AMERICAN GEOPHYSICAL UNION, WASHINGTON, DC.
Urban Stormwater Hydrology.
W87-09096 4C

AMERICAN PETROLEUM INST., WASHINGTON, DC.
Proceedings: 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup).
W87-09507 5B

AMERICAN SOCIETY FOR TESTING MATERIALS, PHILADELPHIA, PA.
Aquatic Toxicology and Hazard Assessment: Eighth Symposium.
W87-08624 6E

AMERICAN WATER WORKS ASSOCIATION, NEW YORK.
Committee Report: Microbiological Considerations for Drinking Water Regulation Revisions,
W87-08959 5F

AMERICAN WATER WORKS ASSOCIATION RESEARCH FOUNDATION, DENVER, CO.
Public Drinking Water and Chemicals,
W87-09117 5C

AMSTERDAM UNIV. (NETHERLANDS). VAKGROEP AQUATISCHE OECOLOGIE.
Method for Measuring Selective Light Attenuation within a Periphytic Community,
W87-08769 7B

AN-NAJAH N. UNIV., NABLUS (ISRAEL). CHEMISTRY DEPT.
Effect of Storage on the Distribution of Trace Elements (Lead, Cadmium, Copper, Zinc and Mercury) in Natural Water,
W87-08914 5A

ANDERSON-NICHOLS, INC., PALO ALTO, CA.
Nonpoint Source Pollution Models for Chemicals,
W87-08673 5B

ANGLIAN WATER AUTHORITY, AMBURY ROAD, HUNTINGDON, CAMBRIDGESHIRE PE186NZ, UK.
Effect of Habitat Modification on Freshwater Fisheries in Lowland Areas of Eastern England,
W87-09050 2H

ANIMAL AND GRASSLAND RESEARCH INST., HURLEY (ENGLAND).
Nitrogenase Activity, Photosynthesis and Nodule Water Potential in Soyabean Plants Experiencing Water Deprivation,
W87-08798 2I

ANNE ARUNDEL COMMUNITY COLL., ARNOLD, MD.
Sampling and Composition of the Surface Microlayer,
W87-09173 5A

AOKAUTERE MINISTRY OF WORKS AND DEVELOPMENT, PALMERSTON NORTH (NEW ZEALAND). SOIL CONSERVATION CENTRE.
Effect of Soil Slip Erosion on Wairoa Hill Pasture Production and Composition,
W87-08734 2J

APPALACHIAN MOUNTAIN CLUB, GORHAM, NH. RESEARCH DEPT.
Two New Ground-Level Cloud Water Sampler Designs Which Reduce Rain Contamination,
W87-08948 7B

APPLIED GEOCHEMISTRY RESEARCH GROUP, ROYAL SCHOOL OF MINES, IMPERIAL COLL., LONDON SW7.
Hydrological and Chemical Factors Controlling the Concentrations of Fe, Cu, Zn and As in a River System Contaminated by Acid Mine Drainage,
W87-09277 5B

ARCHAEOLOGICAL CONSULTING SERVICES, LTD.
Settlement, Subsistence, and Specialization in the Northern Periphery: Research Design for Mitigative Data Recovery at Sites in the New Waddell Dam Borrow Areas,
W87-09094 6G

ARCTEC, INC., COLUMBIA, MD.
Containment of Oil Spilled Under Rough Ice,
W87-09526 5B

ARGONNE NATIONAL LAB., IL. RADIOLOGICAL AND ENVIRONMENTAL RESEARCH DIV.
Exchange of Particles and Gases Across Water Surfaces,
W87-09168 5B

ARIZONA STATE MUSEUM, TUCSON.
Tucson Aqueduct Phase B Central Arizona Project: Archaeological Data Recovery Studies, 1985-1986 Annual Report,
W87-09329 6G

ARIZONA STATE UNIV., TEMPE. DEPT. OF ZOOLOGY.
Impact of Irrigation and Experimental Drought Stress on Leaf-Mining Insects of Emory Oak,
W87-09402 2I

ARIZONA STATE UNIV., TEMPE. OFFICE OF CULTURAL RESOURCE MANAGEMENT.
Prehistoric Hunter-Gatherers of South Central Arizona: The Picacho Reservoir Archaic Project,
W87-09191 6G

ARIZONA UNIV., TUCSON.
Institutional Analysis in Community Decision-Making: A Case Example from Southern Arizona,
W87-08981 6A

ARIZONA UNIV., TUCSON. DEPT. OF AGRICULTURAL ECONOMICS.
Irrigated Agriculture and Groundwater Quality--A Framework for Policy Development,
W87-09212 6A

ARIZONA UNIV., TUCSON. DEPT. OF CHEMISTRY.
Implications of Elemental Characteristics of Humic Substances,
W87-09084 7B

ARIZONA UNIV., TUCSON. DEPT. OF ECONOMICS.
Alternative Demand Model Estimators for Block Rate Pricing,
W87-08984 6C

ARIZONA UNIV., TUCSON. DEPT. OF SOIL AND WATER SCIENCE.
Bare Soil Evaporation Near a Surface Point-Source Emitter,
W87-08743 2D

ARIZONA UNIV., TUCSON. SCHOOL OF RENEWABLE NATURAL RESOURCES.
Preventing Desert Mule Deer Drownings in the Mohawk Canal, Arizona,
W87-09152 6G

ARKANSAS UNIV., FAYETTEVILLE. DEPT. OF CHEMICAL ENGINEERING.
Removal of Traces of Pentachlorophenol from Aqueous Acidic Solutions by Solvent Extraction and Solvent Sublation,
W87-08605 5D

ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS. ENVIRONMENTAL LAB.
Development of a Simplified Column Test for Evaluation of Thickness of Capping Material Required to Isolate Contaminated Dredged Material,
W87-09091 5G

Regulatory Identification of Petroleum Hydrocarbons in Dredged Material,
W87-09154 5A

Evaluation of the Model CE-QUAL-R1 for Use by the Aquatic Plant Control Research Program,
W87-09486 5B

Field Survey of Heavy Metal Uptake by Naturally Occurring Saltwater and Freshwater Marsh Plants,
W87-09490 5B

ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS. HYDRAULICS LAB.
Mathematical Study of the Impact on Salinity Intrusion of Deepening the Lower Mississippi River Navigation Channel,
W87-09095 5B

Post-Pool Raise Spillway Prototype Test for Chief Joseph Dam Columbia River, Washington,
W87-09153 8A

Spectral Analysis of Columbia River Estuary Currents,
W87-09430 2L

Investigation and Discussion of Techniques for Hypolimnion Aeration/Oxygenation,
W87-09481 5G

Erosion Control of Scour During Construction; Report 6: FINITE - A Numerical Model for Combined Refraction and Diffraction of Waves,
W87-09482 8B

Fixed-Cone Valve Prototype Tests, Final Series, New Melones Dam, California,
W87-09483 8C

Low Freshwater Inflow Study: Chesapeake Bay Hydraulic Model Investigation,
W87-09484 2L

Effects of Storage Reallocation on Thermal Characteristics of Cowanesque Lake, Pennsylvania: Numerical Model Investigation,
W87-09485 2H

Pumping Performance and Turbidity Generation of Model 600/100 Pneuma Pump: Main Text and Appendixes A and B,
W87-09487 8C

Kahului Breakwater Stability Study, Kahului, Maui, Hawaii: Hydraulic Model Investigation,
W87-09488 8B

ARMY MEDICAL RESEARCH INST. OF CHEMICAL DEFENSE, ABERDEEN PROVING GROUND, MD.
Determination of Toxic Organophosphorus Compounds by Specific and Nonspecific Detectors,
W87-09220 5A

ARTHUR YOUNG AND CO., CHARLOTTE, NC.
Factors Affecting Water and Wastewater Rates,
W87-09221 6C

ASIAN INST. OF TECH., BANGKOK (THAILAND). DIV. OF ENVIRONMENTAL ENGINEERING.
Importance of Laboratory Scale Study for the Design of Mobile-Bed Filter,
W87-09442 5F

ASOCIACION NACIONAL DE INGENIEROS DE MINAS, CONSEJO SUPERIOR DE COLEGIOS DE INGENIOEROS DE MINAS, GRANADA (SPAIN).
Water in Mining and Underground Works (El Agua en la Mineria y Trabajos Subterraneos), Volumes I and II.
W87-09568 2F

ASSAF HAROFEH MEDICAL CENTER, ZERIFIN (ISRAEL). DEPT. OF MICROBIOLOGY.
Exposure to Legionella in Geriatric Institutions,
W87-08907 5B

ATHENS UNIV. (GREECE).
Problems of Water Inrush into Greek Underground Mines with Special Emphasis to Sea Water Inrush Through Karstic Limestones or Impermeable Formations,
W87-09596 2F

ATMOSPHERIC ENVIRONMENT SERVICE, DOWNSVIEW (ONTARIO).
Canadian Atlantic Storms Program: The Meteorological Field Project,
W87-09255 2B

AUBURN UNIV., AL. DEPT. OF CIVIL ENGINEERING.
Performance and Analysis of Aquifer Tracer Tests with Implications for Contaminant Transport Modeling - A Project Summary,
W87-08759 5B

AUTONOMOUS UNIV. OF BARCELONA (SPAIN). DEPT. OF MICROBIOLOGY.
Ecology of a Cryptomonas phaseolus Population Forming a Metalimnetic Bloom in Lake Ciso, Spain: Annual Distribution and Loss Factors,
W87-08930 2H

BALATON LIMNOLOGICAL RESEARCH INST., TIHANY (HUNGARY).
Effect of Mosquito Killer Insecticides on Freshwater Mussels,
W87-08908 5C

BANARAS HINDU UNIV., VARANASI (INDIA). DEPT. OF ZOOLOGY.
Lead Nitrate Induced Changes in the Thyroid Physiology of the Catfish Clarias batrachus (L),
W87-08850 5C

Impact of Pesticides on Lipid Metabolism in the Freshwater Catfish, Clarias batrachus, during the Vitellogenic Phase of Its Annual Reproductive Cycle,
W87-08851 5C

Pesticide-Induced Changes in Peripheral Thyroid Hormone Levels during Different Reproductive Phases in Heteropneustes fossilis,
W87-08858 5C

BASRAH UNIV. (IRAQ). MARINE SCIENCE CENTER.
Residues of Organochlorine Pesticides in Environmental Samples from the Shatt-al-Arab River, Iraq,
W87-08910 5B

BATTELLE MEMORIAL INST., DENVER, CO. DEPT. OF ENVIRONMENTAL SCIENCES.
Wetlands Policy Crisis: United States and United Kingdom,
W87-09215 6E

BATTELLE NEW ENGLAND MARINE RESEARCH LAB., DUXBURY, MA.
Chronic Toxicity Tests,
W87-09283 5C

Response of Marine Animals to Petroleum and Specific Petroleum Hydrocarbons,
W87-09308 5C

BATTELLE NEW ENGLAND MARINE RESEARCH LAB., DUXBURY, MA. WILLIAM F. CLAPP LABS.
Polycyclic Aromatic Hydrocarbons,
W87-09293 5C

BATTELLE PACIFIC NORTHWEST LABS., RICHLAND, WA.
Usefulness of the Lipid Index for Bioaccumulation Studies with Daphnia magna,
W87-08652 5C

Trees as Indicators of Subterranean Water Flow from a Retired Radioactive Waste Disposal Site,
W87-08845 5A

Determining Optimum Pumping Rates for Creation of Hydraulic Barriers to Ground-Water Pollutant Migration,
W87-09108 5G

Modeling of Atmospheric Wet Deposition,
W87-09165 5B

Measurement of Water Potential in Low-Level Waste Management,
W87-09456 7B

Guidelines for Sampling and Analyzing Solutions from Aquifer Thermal-Energy-Storage Systems,
W87-09457 5A

Information Retrieval System: Impacts of Water-Level Changes on Uses of Federal Storage Reservoirs of the Columbia River; Appendix F: RIVOPR User's Manual,
W87-09477 10B

BATTELLE PACIFIC NORTHWEST LABS., RICHLAND, WA. ENVIRONMENTAL SCIENCES DEPT.
Effects of Suspended Volcanic Ash and Thermal Shock on Susceptibility of Juvenile Salmonids to Disease,
W87-08653 5C

BATTELLE PACIFIC NORTHWEST LABS., SEQUIM, WA. MARINE RESEARCH LAB.
Short-Term Effects of Polynuclear Aromatic Hydrocarbons on Sea-Surface Microlayer Phytoneuston,
W87-09238 5C

Toxicity of Chemically Dispersed Oil to Shrimp Exposed to Constant and Decreasing Concentrations in a Flowing System,
W87-09516 5C

BAYER LANDSSTODT FUR WASHERWIRTSCHAFT, MUNCHEN (GERMANY, F.R.).
Geochemistry and Ecological Role of Humic Substances in Lakewater,
W87-09071 2H

BAYLOR COLL. OF MEDICINE, HOUSTON, TX. DEPT. OF VIROLOGY AND EPIDEMIOLOGY.
A-ELISA to Detect Hepatitis A Virus in Estuarine Samples,
W87-09396 5A

BAYREUTH UNIV. (GERMANY, F.R.). DEPT. OF HYDROLOGY.
Heavy Metals in Lake Kinneret (Israel): II. Hydrogen Sulfide Dependent Precipitation of Copper, Cadmium, Lead and Zinc,
W87-08761 2H

BAYREUTH UNIV. (GERMANY, F.R.). LEHRSTUHL PFLANZENOKOLOGIE.
Field Water Relations of a Compass Plant, Lactuca serriola L.,
W87-08772 2I

BEDFORD INST. OF OCEANOGRAPHY, DARTMOUTH (NOVA SCOTIA).
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W87-09543 5B

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Irrigation with Brackish Water under Desert Conditions: IV. Salt Tolerance Studies with Lettuce (Lactuca sativa L.),
W87-08746 3C

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W87-08715 2H

BINNIE AND PARTNERS, CONSULTING ENGINEERS, 25 NEWGATE STREET, CHESTER, UK.
Concrete Temperature Control During Dam Construction,
W87-09408 8F

BIRMINGHAM UNIV. (ENGLAND). DEPT. OF CHEMISTRY.
Extraction of Humic Substances from Soil,
W87-09079 7B

BLAIR RESEARCH LAB., CAUSEWAY (ZIMBABWE).
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W87-08778 5F

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W87-09109 8I

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W87-08904 5F

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Induction of Crassulacean Acid Metabolism in Mesembryanthemum crystallinum by High Salinity: Mass Increase and de Novo Synthesis of PEP-Carboxylase,
W87-09418 3C

BOWDOIN COLL., BRUNSWICK, ME. MARINE RESEARCH LAB.
Fate of the Zoe Colocotroni Oil Spill and its Effects on Infaunal Communities Associated with Mangroves,
W87-09544 5C

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Influence of Simulated Acidic Rain on Vegetative and Reproductive Tissues of Cucumber (Cucumis sativus L.),
W87-09232 5C

Effects of Simulated Acidic Mist on Germination of Alternaria solani and Phytophthora infestans in vitro and their Infection Efficiency and Sporulation on Potato,
W87-09414 5C

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Epidemiology of Dental Caries in Relation to Environmental Trace Elements,
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Asbestos Fibres Introduce Trace Metals into Streamwater and Sediments,
W87-08912 5B

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Development and Testing of a Weir Boom for Oil Recovery at Sea,
W87-09563 5G

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W87-09510 5G

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W87-08906 5F

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Groundwater Management in France,
W87-09205 2F

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W87-08885 5A

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W87-09012 7B

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Relationship Between Bench Scale and Prototype Activated Sludge Systems,
W87-09449 5D

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American West's Acid Rain Test,
W87-09160 5B

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Understanding the Origin of Radon Indoors--Building a Predictive Capability,
W87-08888 5B

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W87-08996 2G

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W87-09101 2A

Quality of Urban Runoff,
W87-09102 5B

Overview of Urban Stormwater Models,
W87-09104 4C

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Response of Lake Sediments to Changes in Trace Metal Emission from the Smelters at Sudbury, Ontario,
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Scavenging of Atmospheric Sulfate by Arctic Snow,
W87-08947 2C

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W87-09049 4C

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W87-09051 6G

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W87-09569 2F

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W87-08742 4D

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W87-09580 2F

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W87-08756 7C

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W87-09225 2H

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W87-09169 5B

Rational Design of Aerobic Digestion System,
W87-09370 5D

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W87-08995 2G

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Meredosia Oil Terminal - The Illinois River Floods a Tank Farm,
W87-09531 5G

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Cold Weather Response F/V Ryuyo Maru No. 2 St. Paul, Pribiloff Islands, Alaska,
W87-09529 5G

Unique Inland Oil Spill - Glenrock, Wyoming,
W87-09532 5G

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Coast Guard Environmental Mission Fulfilled by Naval Salvage, French Frigate Shoals,
W87-09530 5G

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Hydraulic Model Study of Port Huron Ice Control Structure,
W87-09473 2C

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Spectroscopic Methods (Other Than NMR) for Determining Functionality in Humic Substances,
W87-09087 7B

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Ammonium Bicarbonate-DTPA and DTPA Extractions of Sludge-Amended Soils,
W87-08923 5A

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W87-08697 2B

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Pesticides,
W87-09291 5C

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W87-08631 5C

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W87-09211 6C

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W87-09157 8A

COLUMBIA NATIONAL FISHERIES RESEARCH LAB., MO.
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W87-09289 5C

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W87-09581 2F

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W87-08900 2H

Trace and Nutrient Element Transfer from Sewage Sludge-Amended Soil to Crops: A Study on Brassica oleracea,
W87-08917 5B

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Groundwater Recharge and Discharge Response to Rainfall on a Hillslope,
W87-08706 2F

Dynamics of Sulfate Retention by Acid Forest Soils in an Acidic Deposition Environment,
W87-09008 5B

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Important Issues in the Scale Up of New Processes,
W87-09435 5D

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Analysis of Volume Change in Unconfined Units of Soil,
W87-08992 2G

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Estimating Evapotranspiration,
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W87-08775 2B

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Raw Water Preozonation,
W87-09145 5F

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W87-09366 8B

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W87-08941 2B

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W87-08764 2H

Photosynthesis and Light Adaptation in Epiphyte-Macrophyte Associations Measured by Oxygen Microelectrodes,
W87-08935 7B

CORNELL UNIV. AGRICULTURAL EXPERIMENT STATION, ITHACA, NY. DEPT. OF AGRONOMY.
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W87-09426 7C

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W87-09272 5C

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W87-08601 5F

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W87-09463 2H

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W87-09555 5C

CROP GENETICS GROUP, ABERYSTWYTH (WALES). WELSH PLANT BREEDING STATION.
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W87-08848 2D

CURSO INTERNACIONAL DE HIDROLOGIA SUBTERRANEA Y COMISARIA DE AGUAS DEL

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W87-09574 2F

D'APPOLONIA CONSULTING ENGINEERS, INC., ENGLEWOOD, CO.
Development of a Ground Water Hazard Map for an Underground Coal Mine,
W87-09585 2F

DANISH HYDRAULIC INSTITUTE, HORSHOLM.
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W87-08823 2G

DANISH METEOROLOGICAL INST., COPENHAGEN.
Correction of Liquid Precipitation,
W87-08813 2B

DE PAUL UNIV., CHICAGO, IL.
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W87-09186 5B

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W87-08806 2I

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Metropolitan Water Management,
W87-09338 6D

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W87-09251 5D

Adsorption of 2,4,5-T by Active Carbons from Aqueous Solution,
W87-09254 5D

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W87-08998 2H

DEPARTMENT OF AGRICULTURE, OTTAWA (ONTARIO). LAND RESOURCE RESEARCH INST.
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W87-09467 3F

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W87-09069 2H

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W87-08732 5B

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Determination of Cobalt, Copper, Mercury, and Nickel as Bis(2-hydroxyethyl)dithiocarbamate Complexes by High-Performance Liquid Chromatography,
W87-08831 5A

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W87-09043 6G

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W87-09044 8I

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W87-08882 5C

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W87-08736 2G

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W87-08705 2I

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W87-09512 5B

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W87-08863 2H

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W87-09410 2F

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W87-09328 5A

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W87-09229 5B

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W87-08847 2D

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W87-09390 2H

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W87-09236 5C

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W87-09243 5C

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W87-09241 5C

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W87-09382 5B

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Removal of Phenols by Adsorption on Fly Ash,
W87-09250 5D

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W87-09279 5D

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W87-09386 5G

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On-Line Sulphate Monitoring by Reversed Flow Injection Analysis and Alternating Reagent Injection,
W87-09261 5A

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Expansion of Granular Filters During Backwashing,
W87-09371 5D

Comparison of Backwash Models for Granular Media,
W87-09372 5D

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Modeling Coliform Bacteria Subject to Chlorination,
W87-09375 5D

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W87-09401 2I

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Influence of Substrate Stability on the Composition of Stream Benthos: An Experimental Study,
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W87-09239 5C

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W87-09407 8A

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W87-09394 5C

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Distribution of Protozoa in Subsurface Sediments of a Pristine Groundwater Study Site in Oklahoma,
W87-09395 2H

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Comparative Studies of Plant Growth and Distribution in Relation to Waterlogging: XI. Growth of Geum rivale L. and Geum urbanum L. and Soil Chemical Condition in Experimentally Flooded Soil,
W87-09398 2I

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W87-09399 2I

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W87-09400 2I

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W87-09256 2I

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W87-09258 2G

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W87-08763 2H

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W87-09421 5C

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Characterization of the PAC Profile in Settling Particulates from the Urban Waters of Stockholm,
W87-09237 5B

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Dome's Petroleum Study of Oil and Gas Under Sea Ice,
W87-09525 5G

DOLORES ARCHAEOLOGICAL PROGRAM, CO.
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W87-09330 6G

DOME PETROLEUM LTD., CALGARY (ALBERTA).
Dome Petroleum's Oil Spill Research and Development Program for the Arctic,
W87-09524 5G

DOW CHEMICAL CO., MIDLAND, MI. AGRICULTURAL PRODUCTS DEPT.
Environmental Systems Analysis: An Overview,
W87-08671 5B

DOW CHEMICAL CO., MIDLAND, MI. AGRICULTURAL RESEARCH LAB.
Model for Estimating the Loading Rate of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin to the Great Lakes,
W87-08660 5B

DOW CHEMICAL CO., MIDLAND, MI. DEPT. OF AGRICULTURAL PRODUCTS.
Hydrolysis,
W87-08681 5B

DOW CHEMICAL CO., MIDLAND, MI. DEPT. OF HEALTH AND ENVIRONMENTAL SCIENCES.
Aquatic Hazard Assessment: Picloram,
W87-08643 5C

DOW CHEMICAL CO., MIDLAND, MI. ENVIRONMENTAL SCIENCES RESEARCH.
Biodegradation,
W87-08680 5B

DOW CHEMICAL CO., MIDLAND, MI. MAMMALIAN AND ENVIRONMENTAL TOXICOLOGY.
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W87-08877 5C

DOW CHEMICAL COMPANY, MIDLAND, MI. MAMMALIAN AND ENVIRONMENTAL TOXICOLOGY.
What Industry is Doing to Protect Aquatic Life,
W87-08628 5G

Sensitivity of Chronic Endpoints Used in Daphnia Magna Straus Life-Cycle Tests,
W87-08642 5C

DOW CHEMICAL U.S.A., MIDLAND, MI. DEPT. OF ENVIRONMENTAL QUALITY.
Brood Size and Neonate Weight of Daphnia magna Produced by Nine Diets,
W87-08641 2H

DRINKING WATER RESEARCH FOUNDATION, ALEXANDRIA, VA.
Safe Drinking Water: The Impact of Chemicals on a Limited Resource.
W87-09114 5C

DU PONT DE NEMOURS (E.I.) AND CO., AIKEN, SC. SAVANNAH RIVER LAB.
Leaching Radioactive and Nonradioactive Elements from Actual Savannah River Plant Nuclear Waste Glass,
W87-09112 5B

Seasonal Effects on Ground-Water Chemistry of the Ouachita Mountains,
W87-09428 2K

Orientation Study of St. Francois Mountain and Decaturville Precambrian Areas, Missouri,
W87-09459 2K

DUKE UNIV., DURHAM, NC. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Scale-Up of Solid Bowl Centrifuges for Sludge Dewatering,
W87-09445 5E

DUKE UNIV., DURHAM, NC. DEPT. OF ZOOLOGY.
1986 Lake Nyos Gas Disaster in Cameroon, West Africa,
W87-08780 2H

DUSSELDORF WATERWORKS (GERMANY, F.R.).
Removal of Iron and Manganese by Ozone during Drinking Water Treatment in Dusseldorf,
W87-09136 5F

ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE (SWITZERLAND). DEPT. OF CIVIL ENGINEERING.
Lateral Outflow over Side Weirs,
W87-09196 8A

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Structure and Dynamics of Internal Waves in Baldeggersee,
W87-08864 2H

Dynamics of Bottom Currents in a Small Lake,
W87-08865 2H

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Assessment of Effluent Impacts through Evaluation of Periphyton Diatom Community Structure,
W87-09320 5C

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W87-08853 5B

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W87-09311 5C

EDINGER (J.E.) ASSOCIATES, INC., WAYNE, PA.
Developments in LARM2: A Longitudinal-Vertical, Time-Varying Hydrodynamic Reservoir Model,
W87-09489 8B

EG AND G BIONOMICS, WAREHAM, MA.
Use of Asiatic Clam Larvae in Aquatic Hazard Evaluations,
W87-09326 5C

EG AND G ENVIRONMENTAL GROUP, WELLESLEY, MA.
Effluent Evaluation,
W87-09302 5A

EIDGENOESSISCHE ANSTALT FUER WASSERVERSORGUNG, ABWASSERREINIGUNG UND GEWAESSERSCHULTZ, DUEBENDORF (SWITZERLAND).
Vertical Transport of Heavy Metals by Settling Particles in Lake Zurich,
W87-08869 5B

Air-Water Phase Equilibria of Volatile Organic Solutes,
W87-08956 5F

Simultaneous Determination of Linear Alkylbenzenesulfonates, Alkylphenol Polyethoxylates, and Nonylphenol by High-Performance Liquid Chromatography,
W87-09343 5A

EIDGENOESSISCHE TECHNISCHE HOCHSCHULE, ZURICH (SWITZERLAND).
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W87-09340 2A

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W87-09380 5B

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W87-09276 5B

ENVIRONMENTAL MONITORING AND SUPPORT LAB.-CINCINNATI, OH.
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W87-09312 5C

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Effects of Copper on the Periphyton of a Small Calcareous Stream,
W87-09318 5C

Effects of Exposure Time, Season, Substrate Type, and Planktonic Populations on the Taxonomic Composition of Algal Periphyton on Artificial Substrates in the Ohio and Little Miami Rivers, Ohio,
W87-09321 5C

Comparison of the Hydrophobic-Grid Membrane Filter Procedure and Standard Methods for Coliform Analysis of Water,
W87-09392 5A

ENVIRONMENTAL MONITORING SYSTEMS LAB., LAS VEGAS, NV.
Harmonization of Biological Testing Methodology: A Performance-Based Approach,
W87-08646 5A

Improved Monitoring Techniques to Assess Groundwater Quality Near Sources of Contamination,
W87-09126 5A

ENVIRONMENTAL PROTECTION AGENCY, ATHENS, GA.
Laboratory and Instream Nitrification Rates for Selected Streams,
W87-09378 2H

ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OH. DRINKING WATER RESEARCH DIV.
Applying Economic Principles to Small Water Systems,
W87-08955 6C

Occurrence, Significance, and Detection of Klebsiella in Water Systems,
W87-08958 5A

ENVIRONMENTAL PROTECTION AGENCY, CORVALLIS, OR.
Acclimation as a Factor Influencing Metal Criteria,
W87-08635 5C

ENVIRONMENTAL PROTECTION AGENCY, NARRAGANSETT, RI.
Interlaboratory Comparison of the ASTM Bioconcentration Test Method Using the Eastern Oyster,
W87-08645 5A

ENVIRONMENTAL PROTECTION AGENCY, RESEARCH TRIANGLE PARK, NC. ATMOSPHERIC SCIENCE RESEARCH LAB.
Tracer Study of Vertical Exchange by Cumulus Clouds,
W87-08699 2A

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC.
Example Model Applications,
W87-09105 4C

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC. OFFICE OF ANALYSIS AND EVALUATION.
Clean Water Act Update: A New Role for Toxicology,
W87-08627 6E

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC. OFFICE OF DRINKING WATER.
Occurence of Contamination In Drinking Water From Groundwater Sources,
W87-09125 5B

Regulation of Contaminants In Drinking Water,
W87-09128 5F

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC. OFFICE OF PESTICIDES AND TOXIC SUBSTANCES.
Research Needs in Developing Structure Activity Relationships,
W87-08633 5C

Comparison of QSAR Predictions with Fish Toxicity Screening Data for 110 Phenols,
W87-08637 5C

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC. OFFICE OF WATER REGULATIONS AND STANDARDS.
Water Quality Criteria: Protection of Use Perspective,
W87-08629 5G

ENVIRONMENTAL PROTECTION SERVICE, EDMONTON (ALBERTA).
BIOS Project - Frontier Oil Spill Countermeasures Research,
W87-09523 5G

ENVIRONMENTAL PROTECTION SERVICE, HALIFAX (NOVA SCOTIA).
Kurdistan - An Unusual Spill Successfully Handled,
W87-09527 5G

ENVIRONMENTAL PROTECTION SERVICE, OTTAWA (ONTARIO). ENVIRONMENTAL EMERGENCIES TECHNOLOGY DIV.
Oil Slick Igniter for remote Areas,
W87-09559 5G

ENVIRONMENTAL RESEARCH LAB., ATHENS, GA.
Pollutant Sorption in Environmental Systems, W87-08677 5B

Fate Modeling, W87-09298 5B

Field Validation, W87-09300 7A

ENVIRONMENTAL RESEARCH LAB.-DULUTH, CINCINNATI, OH. NEWTOWN FISH TOXICOLOGY STATION.
Acute and Chronic Toxicity to the Fathead Minnow, Pimephales promelas, of Effluents from a Treatment Plant Receiving Dye and Pigment Processing Wastewater, W87-08656 5C

ENVIRONMENTAL RESEARCH LAB.-DULUTH, MN.
Biological Effects of Continuous and Intermittent Dosing of Outdoor Experimental Streams with Chloropyrifos, W87-08634 5C

Advantages of Using Regression Analysis to Calculate Results of Chronic Toxicity Tests, W87-08650 5C

Effects of Lowered Dissolved Oxygen Concentration on the Toxicity of 1,2,4-Trichlorobenzene to Fathead Minnows, W87-08879 5C

Early Life Stage Toxicity Tests, W87-09282 5C

ENVIRONMENTAL RESEARCH LAB., GULF BREEZE, FL.
Field Confirmation of a Laboratory-Derived Hazard Assessment of the Acute Toxicity of Fenthion to Pink Shrimp, Penaeus duorarum, W87-08638 5C

Microbial Toxicity Studies, W87-09287 5C

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC., GAINESVILLE, FL.
Manual of Stream Channelization Impacts on Fish and Wildlife, W87-09497 6G

ENVIRONMENTAL SCIENCES DIV. LAWRENCE LIVERMORE NATIONAL LAB., LIVERMORE, CA 94550.
New Method for Determining the Concentrations of Volatile Organic Compounds in Sediment Interstitial Water, W87-09233 5A

EOTVOS LORAND UNIV., BUDAPEST (HUNGARY). COMPUTING CENTER.
Stability and Instability of an Adaptive Resource Replacement Strategy in and Agroecological Production System, W87-08784 6A

ETHNOSCIENCE, BILLINGS, MT.
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EUROPEAN INSTITUTE OF ECOLOGY AND CANCER, BRUSSELS (BELGIUM).
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EVERPURE, INC., WESTMONT, IL.
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EXPAND CSIRO, INDOOROOPILLY (AUSTRALIA). LONG POCKET LABS.
Comparative Study on the Intrinsic Rates of Increase of Cyrtobagous singularis and C. salviniae on the Water Weed Salvinia molesta, W87-09217 4A

EXXON CHEMICAL CO., HOUSTON, TX. TECHNOLOGY DIV.
Aerial Application of Dispersants at the Ixtoc I Spill, W87-09534 5G

EXXON CO., U.S.A., HOUSTON, TX. MARINE DEPT.
Response to the Esso Bayway Oil Spill, W87-09549 5G

EXXON CORP., EAST MILLSTONE, NJ. MEDICAL DEPT.
Chemical Safety Evaluation, W87-09301 5B

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Enhancement of Inorganic Nitrogen and Phosphate Release from Lake Sediment by Tubificid Worms and Chironomid Larvae, W87-09404 2H

FACULTY OF SCIENCE, SIMON FRASER UNIV., BRITISH COLUMBIA, CANADA.
Subglacial Drainage for an Ice Sheet Resting Upon a Layered Deformable Bed, W87-09248 2F

FEDERAL OFFICE OF PUBLIC HEALTH, CH-3001 BERN, SWITZERLAND.
Quantification of PCB by Dechlorination to Biphenyl, W87-09259 5A

FIELD STUDIES COUNCIL, PEMBROKE (WALES). OIL POLLUTION RESEARCH UNIT.
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FINKEL AND FINKEL, YOQNEAM (ISRAEL).
Semiarid Soil and Water Conservation, W87-08661 3F

Hydrology, W87-08662 2A

Soil Erosion Process, W87-08663 2J

Agronomic Measures for Soil and Water Conservation, W87-08664 3F

Engineering Measures: Waterways and Diversion Channels, W87-08666 8A

Engineering Measures for Soil and Water Conservation: Terracing and Benching, W87-08667 3F

Engineering Measures: Water Harvesting, W87-08668 3F

Gulley Control, W87-08669 3F

FINNISH GAME AND FISHERIES RESEARCH INST., HELSINKI (FINLAND).
Dredging of Rapids for Timber-Floating in Finland and Its Effects on River-Spawning Fish Stocks, W87-09045 6G

Food of Whitefish (Coregonus lavaretus) in Two Neighbouring Lakes, One Regulated and the Other Natural, W87-09055 2H

Effects of Habitat Modification on Freshwater Crayfish, W87-09062 4C

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Development of Fish Stock and Fish Populations in Lake Inari, W87-09054 2H

Fish Stocks and Fishing in the Lokka and Porttipahta Reservoirs, Northern Finland, W87-09056 2H

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Application of Laboratory Scale Model Streams Toward Assessing Effluent Impacts in Freshwater Lotic Environments, W87-09314 5C

FLORIDA STATE UNIV., TALLAHASSEE. DEPT. OF METEOROLOGY.
Water Vapor Transport Over the Indian Ocean During the 1979 Summer Monsoon. Part I: Water Vapor Fluxes, W87-08937 2B

FLORIDA UNIV., BELLE GLADE, FL. EVERGLADES RESEARCH AND EDUCATION CENTER.
Surge Irrigation Management, W87-08744 3F

FLORIDA UNIV., GAINESVILLE. DEPT. OF ENVIRONMENTAL ENGINEERING SCIENCES.
Atmospheric Deposition of Nitrogen and Phosphorus in Florida, W87-09175 5B

Importance of Atmospheric Fluxes to the Nitrogen Balance of Lakes in the Florida Peninsula, W87-09176 2H

Atmospheric Deposition of Acidity and Sulfur in Florida, W87-09177 5B

FMC CORP., PRINCETON, NJ.
Fundamentals of Aquatic Toxicology: Methods and Applications. W87-09280 5C

Behavior, W87-09288 5C

FORAS FORBARTHA, TEORANTA, DUBLIN (IRELAND). WATER RESOURCES DIV.
Impact of Agriculture on Surface Water in Ireland: Part I. General, W87-09199 5B

FORAS TALUNTAIS, BALLINROBE (IRELAND).
Hydrology and Drainage of Peatland, W87-09201 2G

FORAS TALUNTAIS, BALLINROBE (IRELAND).

Agricultural Drainage Practices in Ireland,
W87-09202 4A

FORAS TALUNTAIS, BALLINROBE (IRELAND). JOHNSTOWN CASTLE RESEARCH CENTRE.
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W87-09200 4C

FREE UNIV., AMSTERDAM (NETHERLANDS). INST. OF EARTH SCIENCES.
Unsteady Flow to Wells in Layered and Fissured Aquifer Systems,
W87-08618 2F

FRESHWATER BIOLOGICAL ASSOC., C/O NORTHUMBERLAND WATER AUTHORITY, LARTINGTON TREATMENT PLANT, BARNARD CASTLE, COUNTY DURHAM, DL129DW, UK.
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W87-09040 6G

FRESHWATER FISHERIES LAB., FASCALLY, PITLOCHRY, PERTHSHIRE, UK. DEPT. OF AGRICULTURE AND FISHERIES.
Afforestation and Fisheries,
W87-09061 4C

GALATI UNIV., 6200 GALATI, ROMANIA.
Effects on Fisheries of Non-Biotic Modifications of the Environment in the East-Danube River Area,
W87-09038 6G

GEOLOGICAL SURVEY, ALBANY, NY. WATER RESOURCES DIV.
Diffusivity of a Glacial-Outwash Aquifer by the Floodwave-Response Technique,
W87-08754 2F

GEOLOGICAL SURVEY, DENVER, CO.
Molecular Size and Weight Measurements of Humic Substances,
W87-09085 7B

Application of Nuclear Magnetic Resonance Spectroscopy for Determining Functionality in Humic Substances,
W87-09088 7B

GEOLOGICAL SURVEY, DENVER, CO. WATER RESOURCES DIV.
Use of Topological Information in Hydrograph Estimation,
W87-08976 2E

Humic Substances in Soil, Sediment, and Water: Geochemistry, Isolation, and Characterization.
W87-09067 2H

Humic Substances in Groundwater,
W87-09070 2F

Geochemistry of Stream Fulvic and Humic Substances,
W87-09073 2H

Isolation and Concentration Techniques for Aquatic Humic Substances,
W87-09080 2H

Fractionation Techniques for Aquatic Humic Substances,
W87-09082 7B

GEOLOGICAL SURVEY, HARRISBURG, PA.
Hydrogeologic Factors that May Affect Mine Drainage in the Anthracite Region of Pennsylvania, Eastern United States,
W87-09577 4C

GEOLOGICAL SURVEY, MENLO PARK, CA.
Evaluation of Natural Tracers in an Acidic and Metal-Rich Stream,
W87-09021 7B

Trace Metals,
W87-09292 5C

GEOLOGICAL SURVEY, NASHVILLE, TN. WATER RESOURCES DIV.
Man-Induced Gradient Adjustment of the South Fork Forked Deer River, West Tennessee,
W87-09206 6G

GEOLOGICAL SURVEY, NSTL STATION, MS. GULF COAST HYDROSCIENCE CENTER.
Data Collection and Instrumentation,
W87-09103 7B

GEOLOGICAL SURVEY OF ISRAEL, JERUSALEM. HYDROGEOLOGICAL DIV.
Proposed Hydrogeological Model for Future Lignite Mining and Groundwater Drainage in the Hula Basin, Northern Israel,
W87-09578 2F

GEOLOGICAL SURVEY, RESTON, VA.
Water-Quality Trends in the Nation's Rivers,
W87-08779 5G

Geochemistry of Humin,
W87-09077 2H

GEOLOGICAL SURVEY, SACRAMENTO, CA. WATER RESOURCES DIV.
Hydraulic/Chemical Changes During Ground-Water Recharge by Injection,
W87-08751 5B

GEOLOGICAL SURVEY, TUSCALOOSA, AL. WATER RESOURCES DIV.
Computation of Unsteady Flows in the Alabama River,
W87-08980 2E

GEORGIA INST. OF TECH., ATLANTA.
Geometric Parameters and Efficiency of Diffused Air Systems,
W87-09437 5D

Development of a New Type of Fluidized Bed Reactor,
W87-09444 5D

GEORGIA INST. OF TECH., ATLANTA. SCHOOL OF GEOPHYSICAL SCIENCES.
Acidic Functional Groups of Humic Substances,
W87-09086 2K

GEORGIA UNIV., ATHENS. DEPT. OF MICROBIOLOGY.
Degradation of Aniline and Chloroanilines by Sunlight and Microbes in Estuarine Water,
W87-09271 5B

GEORGIA UNIV., ATHENS. INST. OF ECOLOGY.
Sestonic Bacteria as a Food Source for Filtering Invertebrates in Two Southeastern Blackwater Rivers,
W87-08870 2H

GEORGIA UNIV., SAPELO ISLAND. MARINE INST.
Predation Risk and Use of Intertidal Habitats by Young Fishes and Shrimp,
W87-08787 2L

Use of Monodispersed, Fluorescently Labeled Bacteria to Estimate In Situ Protozoan Bacterivory,
W87-09388 2H

GEOSYSTEM CONSULTANTS, INC., IRVINE, CA.
Distribution Coefficient of Trichloroethylene in Soil-Water Systems,
W87-08752 5B

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W87-08894 5A

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W87-08703 5C

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W87-08854 5C

GOLD FIELDS OF SOUTH AFRICA LTD., CARLETONVILLE (SOUTH AFRICA).
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W87-09588 2F

GORAKHPUR UNIV. (INDIA). DEPT. OF BOTANY.
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W87-08873 5C

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W87-09179 5B

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W87-09066 2H

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W87-09438 5D

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W87-08856 5B

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W87-08990 7C

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Factors that Modify Toxicity,
W87-09285 5C

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W87-08651 5C

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W87-09284 5C

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W87-08745 5G

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W87-09116 5C

World Health Organization and Guidelines and European Economic Community Directives,
W87-09130 6E

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W87-08613 5C

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W87-08903 5A

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W87-08766 2H

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W87-09192 6G

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W87-09260 5A

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W87-09415 2I

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W87-09083 7B

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Potassium Ferrioxalate as Chemical Actinometer in Ultraviolet Reactors,
W87-09377 5F

IDAHO NATIONAL ENGINEERING LAB., IDAHO FALLS.
Status of DOE Small Hydropower Research and Development Projects.
W87-09478 8C

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W87-09190 5D

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W87-09573 2F

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W87-09092 5G

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W87-08753 2F

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Theory and Practice in the Electrometric Determination of pH in Precipitation,
W87-08949 7B

ILLINOIS UNIV. AT URBANA-CHAMPAIGN.
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W87-09461 8A

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W87-09007 7B

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Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulfur, Micronutrients,
W87-08689 2G

Geochemistry of Soil Humic Substances,
W87-09068 2J

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF CIVIL ENGINEERING.
Rainfall for Urban Stormwater Design,
W87-09098 2B

Environmental Impact Analysis of Aquatic Ecosystems Using Rational Threshold Value Methodologies,
W87-09313 5C

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W87-08799 2H

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W87-09090 2J

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W87-09151 6G

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W87-09155 6G

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W87-09156 6G

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W87-09060 6G

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W87-09076 2J

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W87-08616 2E

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W87-09057 2H

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W87-09593 2F

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W87-08916 5B

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W87-08738 3B

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W87-09015 3F

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W87-09026 7C

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Curbing THMs in Small Water Systems,
W87-08954 5F

Markov Renewal Model for Rainfall Occurrences,
W87-09025 7C

IOWA STATE UNIV., AMES. DEPT. OF STATISTICS.
Robust-Resistant Spatial Analysis of Soil Water Infiltration,
W87-09029 7C

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Modeling Chemical Transport in Lakes, Rivers, and Estuarine Systems,
W87-08672 5B

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W87-09197 8I

Streambank Protection by Submerged Vanes,
W87-09198 4D

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W87-08852 5C

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W87-08748 3F

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W87-09204 5B

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W87-09566 5G

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W87-09384 7C

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W87-09166 5B

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W87-08655 5C

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W87-09052 2H

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Federal Protection of Groundwater,
W87-09129 5G

Regulatory Flexibility and Consumer Options Under the Safe Drinking Water Act,
W87-09131 5F

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W87-08762 2H

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W87-08758 2F

Velocity Control as a Tool for Optimal Plume Containment in the Equus Beds Aquifer, Kansas,
W87-08982 5G

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W87-09144 5F

KARLSRUHE UNIV. (GERMANY, F.R.). INST. FUER HYDROMECHANIK.
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W87-09439 5D

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W87-08896 5A

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W87-08834 2E

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W87-09344 2I

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W87-08630 5C

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W87-08728 5B

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W87-09046 2H

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W87-09264 5B

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W87-09409 8A

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W87-08770 2I

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W87-09548 5C

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W87-08931 2H

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W87-09181 5C

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W87-08793 2H

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W87-09458 5B

Water-Quality Monitoring at the Hoe Creek Test Site: Review and Preliminary Conclusions,
W87-09495 5B

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Measuring Fish Lengths from Instant Photographs Using a Digitizing Tablet and Minicomputer,
W87-08649 7B

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W87-09275 2H

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W87-09081 2G

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W87-09011 5A

Removal of Individual Off-Flavour Compounds in Water During Artificial Groundwater Recharge and During Treatment by Alum Coagulation/Sand Filtration,
W87-09267 5F

LITTLE (ARTHUR D.), INC., CAMBRIDGE, MA.
Estimation of Physical Properties,
W87-08676 5B

Simplified Models to Predict the Breakup of Oil on Rough Seas,
W87-09521 5B

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W87-09037 2H

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W87-08777 5F

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W87-09429 5B

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Air/Soil Exchange Coefficients,
W87-08678 5B

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W87-09016 2J

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W87-08878 5B

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W87-09570 5C

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W87-08826 2E

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W87-09032 6B

MAINE UNIV. AT ORONO. DEPT. OF CHEMICAL ENGINEERING.
Rates of Accumulation of Heavy Metals in Pre- and Post-European Sediments in New England Lakes,
W87-09184 5B

MAINE UNIV. AT ORONO. DEPT. OF PLANT AND SOIL SCIENCES.
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W87-08891 5E

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W87-08849 2L

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W87-09074 2H

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W87-08729 5B

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Exploring Existence Value,
W87-09031 6C

Estimating the Value of Water Quality Improvements in a Recreational Demand Framework,
W87-09033 6C

MARYLAND UNIV., COLLEGE PARK. DEPT. OF AGRONOMY.
Residual Effects of Sewage Sludge on Soybean: I. Accumulation of Heavy Metals,
W87-08921 5C

Residual Effects of Sewage Sludge on Soybean: II. Accumulation of Soil and Symbiotically Fixed Nitrogen,
W87-08922 5C

Carolina Bays on the Eastern Shore of Maryland: I. Soil Characterization and Classification,
W87-08999 2H

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Empirical Prediction of the Summer Monsoon Rainfall over India,
W87-08940 2B

MARYLAND UNIV., SOLOMONS. CENTER FOR ENVIRONMENTAL AND ESTUARINE STUDIES.
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W87-09393 5B

MASON AND HANGER-SILAS MASON CO., INC., LEONARDO, NJ.
Open Ocean Skimmer Performance Tests,
W87-09562 5G

Coherent, Plunging Water Jets for Oil Spill Control,
W87-09565 5G

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Spring and Summer Movements of Subadult Striped Bass, Morone saxatilis, in the Connecticut River,
W87-09253 2H

MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF CIVIL ENGINEERING.
Adsorption of Inorganic Pollutants in Aquatic Systems,
W87-09194 5B

MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF EARTH AND PLANETARY SCIENCES.
Selenium in the Tributaries of the Orinoco in Venezuela,
W87-09406 2K

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W87-09305 2K

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Sediment Diffusion in Primary Shallow Rectangular Clarifiers,
W87-09376 5F

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Advances in Irrigation, Volume 3.
W87-09464 3F

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Fate and Effects of Dispersant-Treated Compared with Untreated Crude Oil, with Particular Reference to Sheltered Intertidal Sediments,
W87-09537 5G

MCGILL RADAR WEATHER OBSERVATORY, STE. ANN DE BELLEVUE (QUEBEC).
Relative Accuracy of Satellite and Raingage Rainfall Measurements over Middle Latitudes during Daylight Hours,
W87-08700 2B

MCGILL UNIV., MONTREAL (QUEBEC). DEPT. OF BIOLOGY.
Regulation of Submerged Aquatic Plant Distribution in a Uniform Area of a Weedbed,
W87-08836 2H

Mathematical Model of Seasonal and Spatial Variation in Phosphorus Concentrations in Lake Memphremagog, Quebec,
W87-08899 5B

Algal Phagotrophy: Regulating Factors and Importance Relative to Photosynthesis in Dinobryon (Chrysophyceae),
W87-08929 2H

Glutathione Status and Protein Synthesis During Drought and Subsequent Rehydration in Tortula ruralis,
W87-09417 2I

MCI CONSULTING ENGINEERS, INC., NASHVILLE, TN.
Design of Spillway Crests,
W87-09195 8A

MCKESSON OPERATIONS RESOURCE GROUP, SAN FRANCISCO, CALIFORNIA. GOVERNMENT RELATIONS AND SCIENTIFIC AFFAIRS.
Bottled Water: An Alternative Source of Safe Drinking Water,
W87-09118 5F

MCMASTER UNIV., HAMILTON (ONTARIO). DEPT. OF GEOLOGY.
Acid Neutralizing Capacity of Fine Soil Fractions,
W87-09180 2G

MEDICAL ACADEMY, GDANSK (POLAND). DEPT. OF ANALYTICAL CHEMISTRY.
Some Metals and Their Possible Sources in Rain Water of the Southern Baltic Coast, 1976 and 1978-1980,
W87-08726 5B

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Theory of Secondary Production Calculations for Continuously Reproducing Populations,
W87-08862 2L

METEOROLOGICAL OFFICE, BRACKNELL (ENGLAND).
Snow Forecasts from the Meteorlogical Office Fine-mesh Model During the Winter of 1985/86,
W87-08702 2B

Rainfall Pattern Associated with a Split Cold Front as Seen on FRONTIERS,
W87-08800 2B

MIAMI UNIV., FL. DEPT. OF MECHANICAL ENGINEERING.
Predictive Application of an ORNL Geohydrology Model,
W87-08760 7C

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF CROP AND SOIL SCIENCES.
Mobility of Sludge-Borne 3,3'-Dichlorobenzidine in Soil Columns,
W87-08925 5B

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF FISHERIES AND WILDLIFE.
Multispecies Tests: Research Needs to Assess the Effects of Chemicals on Aquatic Life,
W87-08632 5A

MICHIGAN TECHNOLOGICAL UNIV., HOUGHTON. DEPT. OF CIVIL ENGINEERING.
Prediction of Fixed-Bed Adsorber Removal of Organics in Unknown Mixtures,
W87-09369 5D

MICHIGAN UNIV., ANN ARBOR.
Metal Precipitation in Two Landfill Leachates,
W87-09368 5G

MICHIGAN UNIV., ANN ARBOR. DEPT. OF ATMOSPHERIC AND OCEANIC SCIENCE.
Organic Matter and Heavy Metal Concentrations in the Particulate Phase of Lake Michigan Surface Microlayers,
W87-09171 5B

MICHIGAN UNIV., ANN ARBOR. DEPT. OF CIVIL ENGINEERING.
Modeling for Process Scale-Up of Adsorption and Ion Exchange Systems,
W87-09446 5D

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Assessment and Prediction of Impacts of Effluents on Communities of Benthic Stream Macroinvertebrates,
W87-09324 5C

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Fate of 14C-Lindane in a Rice-Fish Model Ecosystem,
W87-08915 5B

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Hydrogeological Aspects of Agricultural Drainage in Ireland,
W87-09203 2E

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Plans and Experiments to Deal with Large Amounts of Sediment in Hungarian Mines under Karstic Water Hazard,
W87-09590 4C

Forecasting the Rates of Water Inflowing into Mines,
W87-09599 2F

Water Control Strategy of Mines Under Strong Karstic Water Hazard,
W87-09600 4B

MINISTERE DE L'AGRICULTURE, PARIS (FRANCE). LABORATOIRE CENTRAL D'HYGIENE ALIMENTAIRE.
Contamination of Fish from the French Zone of Lake Leman by Organochlorine Compounds between 1973 and 1981 (Contamination des Poissons du Secteur Francais du Lac Leman, par les Composes Organochlores entre 1973 et 1981),
W87-08909 2H

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Resuspension in the Shallow Sublittoral Zone of a Macrotidal Estuarine Environment: Wind Influence,
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Leaching Losses from Irrigated Pasture: Waiau Irrigation Scheme, North Canterbury,
W87-08737 5B

MINISTRY OF WORKS AND DEVELOPMENT, HAMILTON (NEW ZEALAND). WATER QUALITY CENTRE.
Absorption of Light by Yellow Substance in Freshwater Lakes,
W87-08934 2H

MINNESOTA AGRICULTURAL EXPERIMENT STATION, ST. PAUL.
Soybean Growth and Boron Distribution in a Sandy Soil Amended with Scrubber Sludge,
W87-08927 5C

MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF CIVIL AND MINING ENGINEERING.
Trace Metal and Strong Acid Composition of Rain and Snow in Northern Minnesota,
W87-09178 5B

Atmospheric Concentrations and Deposition of Polychlorinated Biphenyls to Lake Superior,
W87-09185 5B

MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF ECOLOGY AND BEHAVIORAL BIOLOGY.
Appropriate Durations and Measures for Ceriodaphnia Toxicity Tests,
W87-08654 5C

MINNESOTA UNIV., MINNEAPOLIS. ST. ANTHONY FALLS HYDRAULIC LAB.
Error Analysis of Conventional Discrete and Gradient Dynamic Programming,
W87-09023 7C

MISSISSIPPI STATE UNIV., MISSISSIPPI STATE. DEPT. OF BIOLOGICAL SCIENCES.
Effect of Crude Oil on Microbial Processes in Marine Sediments,
W87-09567 5C

MISSOURI DEPARTMENT OF CONSERVATION, COLUMBIA.
Use of the Pocketbook Mussel, Lampsilis ventricosa, for Monitoring Heavy Metal Pollution in an Ozark Stream,
W87-08875 5A

MITRE CORP., MCLEAN, VA.
Acute Toxicity of Chlorine on Freshwater Organisms: Time-Concentration Relationships of Constant and Intermittent Exposures,
W87-08640 5C

MIXING EQUIPMENT CO., ROCHESTER, NY.
Perspectives on the Scale-Up of Impeller Mixers,
W87-09434 5D

MOBIL OIL CORPORATION, NEW YORK.
Atlantic Empress Sinking - A Large Spill Without Environmental Disaster,
W87-09553 5C

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Flood Damage Model for Flood Plain Studies,
W87-08965 2E

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Geotechnical Aspects of Corani Reservoir Enlargement,
W87-08794 8A

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Physical/Chemical Properties of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin,
W87-08657 5B

Environmental Mobility of Dioxins,
W87-08658 5B

MONTANA STATE UNIV., BOZEMAN. DEPT. OF BIOLOGY.
Photosynthate Distribution by Microplankton in Permanently Ice-Covered Antarctic Desert Lakes,
W87-08872 2H

MONTANA STATE UNIV., BOZEMAN. DEPT. OF MICROBIOLOGY.
Operational Variables and the Release of Colonized Granular Activated Carbon Particles in Drinking Water,
W87-08957 5F

MONTANA STATE UNIV., BOZEMAN. FISHERIES BIOASSAY LAB.
Ammonia, Nitrite, and Nitrate,
W87-09294 5C

MONTREAL ENGINEERING CO. LTD., CALGARY (ALBERTA).
Assessment of Aerial Application of Oil Spill Dispersants,
W87-09533 5G

MONTREAL UNIV. (QUEBEC). DEPT. OF GEOGRAPHY.
Rainfall Acidity as Related to Meteorological Parameters in Northern Quebec,
W87-08943 2B

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Digestion of Carbohydrates and Protein by Gammarus mucronatus Say (Amphipoda),
W87-08839 2L

MUNICIPAL ENVIRONMENTAL RESEARCH LAB., CINCINNATI, OH. DRINKING WATER RESEARCH DIV.
Disinfectant Chemistry In Drinking Water - Overview of Impacts on Drinking Water Quality,
W87-09122 5F

MURRAY STATE UNIV., KY. DEPT. OF BIOLOGICAL SCIENCES.
Toxicity of Aqueous Extracts of Natural and Synthetic Oils to Three Species of Lemna,
W87-08647 5C

NAGOYA UNIV. (JAPAN). WATER RESEARCH INST.
Pattern of Organic Matter Production by Natural Phytoplankton Population in a Eutrophic Lake 1. Intracellular Products,
W87-08767 2H

NASA AMES RESEARCH CENTER, MOFFETT FIELD, CA 94035, USA.
Turbulence Statistics in Fully Developed Channel Flow at Low Reynolds Number,
W87-09383 8B

NATIONAL BOARD OF WATERS, HELSINKI (FINLAND).
Operational Spring Time Forecasting Difficulties and Improvements,
W87-08824 2E

Water Level Regulation of Lake Inari: Impacts and Compensation Measures,
W87-09053 2H

Influence of Meltwater on the Amount and Composition of Groundwater in Quaternary Deposits in Finland,
W87-09460 2F

NATIONAL BUREAU OF STANDARDS, WASHINGTON, DC. OFFICE OF STANDARD REFERENCE MATERIALS.
NBS Environmental Standard Reference Materials for Use in Validating Water Analysis,
W87-09127 5A

NATIONAL CENTER FOR ANALYSIS OF ENERGY SYSTEMS, UPTON, NY. BIOMEDICAL AND ENVIRONMENTAL ASSESSMENT DIV.
Environmental Aspects of Energy Related Solid Waste,
W87-09427 5E

NATIONAL CENTER FOR TOXICOLOGICAL RESEARCH, JEFFERSON, AR. DIV. OF CHEMISTRY.
Use of Bullfrogs (Rana catesbeiana) as Biological Markers for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin Contamination in the Environment,
W87-08733 5A

NATIONAL COASTAL ECOSYSTEMS TEAM, SLIDELL, LA.
Coastal Ecosystem Studies and Their Application to Oil Spill Response,
W87-09539 5C

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Transformation of Input to a Stochastic Model Using a Distribution Deterministic Model,
W87-08825 2E

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Toxicity of Chemical Mixtures,
W87-09286 5C

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Evaluation of the Multitest Medium for Rapid Presumptive Identification of Vibrio cholerae from Environmental Sources,
W87-09397 5A

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Toxicity of Ballast-Water Treatment Effluent to Marine Organisms at Port Valdez, Alaska,
W87-09514 5C

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Effect of Ingested Benzo(a)pyrene and Cadmium on Tissue Accumulation, Hydroxylase Activity, and Intestinal Morphology of the Black Sea Bass, Centropristis striata,
W87-08842 5C

NATIONAL MARINE FISHERIES SERVICE, GALVESTON, TX. GALVESTON LAB.
Fish Predation on Juvenile Brown Shrimp, Penaeus Aztecus Ives: Effects of Turbidity and Substratum on Predation Rates,
W87-09252 2H

NATIONAL MARINE FISHERIES SERVICE, SEATTLE, WA. NORTHWEST AND ALASKA FISHERIES CENTER.
Review of Effects of Environmental Degradation on the Freshwater Stages of Anadromous Fish,
W87-09042 2H

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, MIAMI, FL. ATLANTIC OCEANOGRAPHIC AND METEOROLOGICAL LABS.
Geochemistry of Humic Substances in Seawater,
W87-09075 2L

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, SEATTLE, WA. PACIFIC MARINE ENVIRONMENTAL LAB.
Theory of Fluorescent Irradiance Fields in Lakes and Seas,
W87-09193 5A

Suspended Particulate Matter in Commencement Bay,
W87-09498 2J

Climate Forecast Verifications, U.S. Mainland, 1974-82,
W87-09499 2B

Focus: Fisheries Oceanography Cooperative Users System,
W87-09500 7C

Data Intercomparison Theory I. Minimal Spanning Tree Tests for Location and Scale Differences,
W87-09501 7C

Data Intercomparison Theory V. Case Study: Effects of Objective Analysis on a Tropical Pacific Sea Surface Temperature Set,
W87-09502 7C

Data Intercomparison Theory IV. Tercile Tests for Location, Spread and Pattern Differences,
W87-09503 7C

Data Intercomparison Theory II. Trinity Statistics for Location, Spread and Pattern Differences,
W87-09504 7C

Data Intercomparison Theory III. S-Phase and T-Phase Tests for Spatial Pattern and Temporal Evolution,
W87-09505 7C

Processes Affecting the Distribution of Low-Molecular-Weight Aliphatic Hydrocarbons in Cook Inlet, Alaska,
W87-09506 5B

NATIONAL PARK SERVICE, PORTER, IN. INDIANA DUNES NATIONAL LAKESHORE.
Hydrology, Water Chemistry and Ecological Relations in the Raised Mound of Cowles Bog,
W87-08837 2H

NATIONAL PARK SERVICE, SAN FRANCISCO, CA. WESTERN REGION.
Coolidge Dam: Photographs Written Historical and Descriptive Data Reduced Copies of Drawings,
W87-09163 8A

NATIONAL PHYSICAL RESEARCH LAB. (SOUTH AFRICA). NATURAL ISOTOPES DIV.
15N/14N Ratios of Nitrate and Ammonium in Rain at Pretoria, South Africa,
W87-08944 2B

NATIONAL RESEARCH COUNCIL OF CANADA, OTTAWA (ONTARIO). DIV. OF CHEMISTRY.
Recovery of Organics from Tailings Pond Sludge Using Coke for Agglomeration,
W87-08602 5D

Determination of Trace Metals in a River Water Reference Material by Inductively Coupled Plasma Mass Spectrometry,
W87-08832 5A

NATIONAL RESEARCH COUNCIL OF CANADA, OTTAWA (ONTARIO). INST. FOR RESEARCH IN CONSTRUCTION.
Measurement of Soil Water Content Using the Combined Time-Domain Reflectometry - Thermal Conductivity Probe,
W87-08796 2G

NATIONAL RESEARCH COUNCIL, WASHINGTON, DC. FOOD AND NUTRITION BOARD.
Water Treatment Chemicals Codex,
W87-09121 5F

NATIONAL SANITATION FOUNDATION, ANN ARBOR, MI.
Effective Alternative to Official Regulation of Indirect Additives to Drinking Water,
W87-09120 5F

NATIONAL UNIV. OF SINGAPORE. DEPT. OF CIVIL ENGINEERING.
Biodegradation of Phenols in an Integrated Activated Carbon Bed and Suspended Aerobic Biological Growth Reactor,
W87-08774 5D

NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO).
Chemistry of the River Niger I. Major Ions,
W87-08719 2K

Chemistry of the River Niger II. Trace Metals,
W87-08720 2K

Use of Bog Vegetation as a Monitor of Atmospheric Input of Metals,
W87-09182 5C

NATIONAL WEATHER SERVICE, SILVER SPRING, MD. HYDROLOGIC RESEARCH LAB.
Radar Rainfall Data Quality Control by the Influence Function Method,
W87-09022 7C

NCHANGA CONSOLIDATED COPPER MINES LIMITED, CHINGOLA (ZAMBIA). GEOLOGY DEPT.
Mine and Open Pit Dewatering at Chingola, Zambia,
W87-09584 4B

NCHANGA CONSOLIDATED COPPER MINES LIMITED, KITWE (ZAMBIA). GEOLOGY DEPT.
Influence of Structure on Underground Water Prediction and Occurrence at Rokana Mine, Kitwe, Zambia,
W87-09572 2F

NEBRASKA UNIV.-LINCOLN. DEPT. OF AGRONOMY.
Quasi-Solution of Richards' Equation for the Downward Infiltration of Water into Soil,
W87-09019 2G

NEBRASKA UNIV.-LINCOLN. DEPT. OF CIVIL ENGINEERING.
Geographic Information System to Predict Non-Point Source Pollution Potential,
W87-08977 7A

NEVADA UNIV. SYSTEM, LAS VEGAS. DESERT RESEARCH INST.
Open-Channel Hydraulics,
W87-08688 8B

NEVADA UNIV. SYSTEM, RENO. DESERT RESEARCH INST.
SO2 Oxidation in Cloud Drops Containing NaCl or Sea Salt as Condensation Nuclei,
W87-08950 6E

NEW HAMPSHIRE UNIV., DURHAM.
Fluvial Hydrology,
W87-08685 2A

NEW HAMPSHIRE UNIV., DURHAM. DEPT. OF CHEMISTRY.
Adsorptive Behavior of Butyltin Compounds Under Simulated Estuarine Conditions,
W87-08730 5B

Accuracy of Selective Extraction Procedures for Metal Speciation in Model Aquatic Sediments,
W87-08985 5A

NEW HAMPSHIRE UNIV., DURHAM. INST. FOR THE STUDY OF EARTH, OCEANS AND SPACE.
Seasonal and Spatial Trends in South Greenland Snow Chemistry,
W87-08946 5B

NEW HAMPSHIRE UNIV., DURHAM. JACKSON ESTUARINE LAB.
Systematics and Ecology of Lyngbya spp. and Associated Species (Cyanophyta) in a New England Salt Marsh,
W87-09423 2L

NEW JERSEY INST. OF TECH., NEWARK. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Groundwater-Leachate: Modeling/Monitoring/Sampling,
W87-09089 5B

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Gravity Drainage Analysis for Scale Heterogeneous Porous Materials Under Falling Water Table Conditions,
W87-09020 2G

NEW YORK STATE COLL. OF AGRICULTURE AND LIFE SCIENCES, ITHACA. BOYCE THOMPSON INSTITUTE FOR PLANT RESEARCH.
Effect of Fertilization with Municipal Sludge on the Glutathione, Polyamine, and Cadmium Content of Cole Crops and Associated Loopers (Trichoplusia ni),
W87-08835 5C

NEW YORK STATE COLL. OF AGRICULTURE AND LIFE SCIENCES, ITHACA. DEPT. OF AGRICULTURAL ENGINEERING.
Capillarity Correction for Free Surface Flow of Groundwater,
W87-09018 2F

NEW YORK UNIV., NY. COURANT INST. OF MATHEMATICAL SCIENCES.
Scanning Currents in Stokes Flow and the Efficient Feeding of Small Organisms,
W87-09385 2H

NEWCASTLE UPON TYNE UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING.
Applications of Porous Membranes for Biomass Retention in Biological Wastewater Treatment Processes,
W87-08889 5D

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF SOIL SCIENCE.
Riparian Areas as Filters for Agricultural Sediment,
W87-09002 4A

Semiportable Multislot Divisor for Erosion and Runoff Measurements,
W87-09010 7B

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF STATISTICS.
Prediction of the Occurrence of Four Species of Mosquito Larvae with Logistic Regression on Water-Chemistry Variables,
W87-08846 2H

NORTH CAROLINA STATE UNIV. AT RALEIGH. SCHOOL OF AGRICULTURE AND LIFE SCIENCES.
Swine Lagoon Effluent Applied to Coastal Bermudagrass,
W87-09472 5D

NORTH CAROLINA UNIV. AT CHAPEL HILL. DEPT. OF ENVIRONMENTAL SCIENCES AND ENGINEERING.
Age-Dependent Lung Doses from Ingested 222Rn in Drinking Water,
W87-08844 5C

By-Products of Chlorination: Specific Compounds and Their Relationship to Total Organic Halogen,
W87-09123 5F

Relationship Between Water-System Size and 222Rn Concentration in North Carolina Public Water Supplies,
W87-09218 5F

NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION, FARGO.
Vacuum Trough Extractors for Measuring Drainage and Nitrate Flux Through Sandy Soils,
W87-08989 7B

NORTH DAKOTA STATE UNIV., MANDAN. LAND RECLAMATION RESEARCH CENTER.
Slope Gradient Effect on Erosion of Reshaped Spoil,
W87-09000 2J

NORTH TEXAS STATE UNIV., DENTON. INST. OF APPLIED SCIENCES.
Hexavalent Chromium Effects on Carbon Assimilation in Selenastrum capricornutum,
W87-08886 5C

NORTH WEST WATER AUTHORITY, WARRINGTON, CHESHIRE, UK.
Assessment of the Flow Requirements for Upstream Migration of Salmonids in Some Rivers of North-West England,
W87-09058 2H

NORTHEAST LOUISIANA UNIV., MONROE. SCHOOL OF PHARMACY.
Influence of Cadmium Exposure on Selected Hematological Parameters in Freshwater Teleost, Notemigonus crysoleucas,
W87-08857 5C

NORTHEASTERN FOREST EXPERIMENT STATION, BROOMALL, PA.
Stream Water Quality in the Coal Region of Virginia,
W87-09494 4C

NORTHEASTERN UNIV., BOSTON, MA. DEPT. OF CHEMISTRY.
Analytical Chemistry,
W87-09295 5B

NORWEGIAN COLLEGE OF VETERINARY MEDICINE, OSLO. DEPT. OF FOOD HYGIENE.
Freshly Prepared Rat Hepatocytes Used in Screening the Toxicity of Blue-Green Algal Blooms,
W87-09230 5A

NORWEGIAN WATER RESOURCES AND ENERGY ADMINISTRATION, OSLO.
Temperature and Flow Conditions in a Reservoir with a Submerged Outlet Tunnel During the Winter Period,
W87-08828 2H

NORWEGIAN WATER RESOURCES AND ENERGY ADMINISTRATION, OSLO (NORWAY).
New Procedures for Flood Estimation in Norway,
W87-08811 2E

NSTA-ASEAN BIOGAS PROJECT, MANILLA (PHILIPPINES).
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W87-08890 5D

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Environmental Specimen Bank Specific Reference Materials - Main Aims and Preparation,
W87-08918 5A

NUS CORP., AIKEN, SC.
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W87-08975 2H

O'CONNOR (M.J.) AND ASSOCIATES LTD., CALGARY (ALBERTA).
Contamination of Groundwater by Hydrocarbons from a Refinery - A Case History,
W87-09547 5G

OAK RIDGE NATIONAL LAB., TN.
Simulation of the Hydrologic Cycle for Watersheds,
W87-09111 2A

Development Programs in the United States of America for the Application of Cement-Based Grouts in Radioactive Waste Management,
W87-09113 5E

OHIO STATE UNIV., COLUMBUS. WATER RESOURCES CENTER.
Determination of Monomeric and Polynuclear Aluminum(III) Species and Hydrolysis Constants,
W87-08611 1B

OKLAHOMA DEPT. OF AGRICULTURE, BROKEN BOW. FORESTRY DIV.
Digital Controller for Discrete Stage Activation of Automatic Pumping Samplers,
W87-08983 7B

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF AGRONOMY.
Leaf Photosynthesis and Conductance of Selected Triticum Species at Different Water Potentials,
W87-09419 2I

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF ZOOLOGY.
Lake Loading Ratios (N:P) and Lacustrine Nitrogen Fixation,
W87-08972 2H

OKLAHOMA UNIV., NORMAN.
Removal of Multivalent Metal Cations from Water Using Micellular-Enhanced Ultrafiltration,
W87-09223 2K

OKLAHOMA UNIV., NORMAN. ENVIRONMENTAL AND GROUND WATER INST.
Ground Water Pollution Control,
W87-09150 5G

Septic Tank System Effects on Ground Water Quality,
W87-09310 5C

ONTARIO MINISTRY OF THE ENVIRONMENT, REXDALE. LIMNOLOGY AND TAXONOMY SECTION.
Input of Biologically Available Phosphorus by Precipitation to Precambrian Lakes,
W87-09174 5B

ONTARIO MINISTRY OF THE ENVIRONMENT, TORONTO. AIR RESOURCES BRANCH.
Analysis of the Impact of the Sudbury Smelters on Wet and Dry Deposition in Ontario,
W87-08942 5B

OPERATIONAL RESEARCH GROUP, SILSOE (ENGLAND).
Economics of the Treatment of Dairy Cow Slurry by Anaerobic Digestion,
W87-09216 5D

OREGON GRADUATE CENTER, BEAVERTON. DEPT. OF ENVIRONMENTAL SCIENCE AND ENGINEERING.
Monitoring Well Installation, Purging, and Sampling Techniques - Part 1: Conceptualizations,
W87-08755 7B

OREGON STATE UNIV., CORVALLIS. DEPT. OF ATMOSPHERIC SCIENCES.
Consistent Parameterization of the Effects of Cumulus Clouds on the Large-Scale Momentum and Vorticity Fields,
W87-08938 2B

ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK, DELFT (NETHERLANDS).
Safety Factor for LC50 Values Allowing for Differences in Sensitivity Among Species,
W87-09266 5C

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W87-09336 6G

OSAKA PREFECTURE UNIV., SAKAI (JAPAN). DEPT. OF CHEMICAL ENGINEERING.
Separation of Mercury from Aqueous Mercuric Chloride Solutions by Onion Skins,
W87-08606 5D

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W87-09436 5C

OSLO UNIV. (NORWAY). INST. FOR GEOPHYSICS.
Runoff Studies in a Small Catchment,
W87-08822 2E

OSSERVATORIO GEOFISICO SPERIMENTALE, TRIESTE (ITALY).
Optimization of Closure Operations in a Tidal Basin During a Storm-Surge,
W87-08610 4A

OTTAWA UNIV. (ONTARIO). DEPT. OF BIOLOGY.
Bacteria as Structuring Agents in Lakes: Field Manipulations with Bacterioplankton,
W87-08768 2H

OXFORD UNIV. (ENGLAND). DEPT. OF ENGINEERING SCIENCE.
BASIC Soil Mechanics,
W87-09307 8D

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Vulnerability of Selected Lakes and Streams in the Middle Atlantic Region to Acidification: A Regional Survey,
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W87-09100 2A

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W87-08986 5A

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Bioaccumulation,
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Removal of Color from Drinking Water with Ozone,
W87-09138 5F

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W87-08626 6E

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W87-09586 2F

UNIVERSIDAD DE GRANADA (SPAIN). DEPT. OF HYDROGEOLOGY.
Hydrogeological Problems Affecting the Exploitation of the Peat Bog at Padul (Granad, Spain). Preliminary Study (Problemas Hidrogeologicos que Afectan a la Explotacion de la Turbera de Padul (Granad, Espana). Estudio Preliminar),
W87-09576 4A

UNIVERSIDADE ESTADUAL DE CAMPINAS (BRAZIL). INST. DE QUIMICA.
Role of Cupric Ions in the Generation of Superoxide in Natural Waters,
W87-08716 2K

UNIVERSIDADE FEDERAL DO RIO DE JANEIRO (BRAZIL). INST. DE BIOFISICA.
Heavy Metal Pollution in the Paraiba do Sul River, Brazil,
W87-08718 5B

UNIVERSIDADE FEDERAL FLUMINENSE, NITEROI (BRAZIL). DEPT. DE GEOQUIMICA.
Geochemical Partitioning of Heavy Metals in Sediments of Three Estuaries Along the Coast of Rio de Janeiro (Brazil),
W87-08717 2L

UNIVERSITY COLL., GALWAY (IRELAND). DEPT. OF ENGINEERING HYDROLOGY.
Review of Methods of Parameter Estimation for the Extreme Value Type-1 Distribution,
W87-08619 7C

UNIVERSITY HOSPITAL OF WALES (CARDIFF). PUBLIC HEALTH LAB.
Bacteriological Quality of Drinks From Vending Machines,
W87-08704 5F

UNIVERSITY OF EAST ANGLIA, NORWICH (ENGLAND). SCHOOL OF ENVIRONMENTAL SCIENCES.
Effect of Polluted and Leached Snow Melt Waters on the Soil Bacterial Community--Quantitative Response,
W87-08874 5C

Spatial Variability in the Chemical Composition of Snowcover in a Small, Remote, Scottish Catchment,
W87-08945 5B

Principles and Problems of Modeling Cation Enrichment at Natural Air-Water Interfaces,
W87-09170 5B

UNIVERSITY OF PETROLEUM AND MINERALS, DHAHRAN (SAUDI ARABIA).
Spreading, Dispersion, and Evaporation of Oil Slicks in the Arabian Gulf,
W87-09522 5B

UNIVERSITY OF ROORKEE (INDIA).
Mechanics of Sediment Transportation and Alluvial Stream Problems,
W87-09337 2J

UNIVERSITY OF THE SOUTH PACIFIC, SUVA (FIJI). DEPT. OF BIOLOGY.
Responses of Leaf Water Potential and Leaf Diffusive Resistance to Abscisic Acid, Water Stress and Low Temperature in Hibiscus esculentus: The Effect of Water Stress and ABA Pre-Treatments,
W87-09210 2D

UNIVERSITY OF WEST FLORIDA, PENSACOLA. DEPT. OF BIOLOGY.
Effects of Triethylene Glycol on Mysidopsis bahia (Crustacea: Mysidacea) and Menidia peninsulae (Pisces: Atherinidae),
W87-08644 5C

UPPSALA UNIV. (SWEDEN). DIV. OF HYDROLOGY.
Estimation of Canopy Reservoir Capacity and Oxygen-18 Fractionation in Throughfall in a Pine Forest,
W87-08814 2B

Lateral Mixing in Channels Due to Secondary Currents,
W87-08827 2E

UPPSALA UNIV. (SWEDEN). INST. OF LIMNOLOGY.
Thymidine Incorporation and Microbial Respiration in the Surface Sediment of a Hypereutrophic Lake,
W87-08936 2H

UPSTATE FRESHWATER INST., INC., SYRACUSE, NY.
Spatial Variability in Selected Physical Characteristics and Processes in Cross Lake, New York,
W87-08973 2H

UPSTATE FRESHWATER INST., SYRACUSE, NY.
Effect of 'Whiting' on Optical Properties and Turbidity in Owasco Lake, New York,
W87-08966 2H

UTAH AGRICULTURAL EXPERIMENT STATION, LOGAN.
Field Method for Estimating Hydraulic Conductivity and Matric Potential-Water Content Relations,
W87-08993 2G

UTAH STATE UNIV., LOGAN. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Statistical Structure and Filter Characteristics of Tritium Fluctuations in Fractured Basalt,
W87-09027 5B

UTAH STATE UNIV., LOGAN. DEPT. OF FOREST RESOURCES.
Steady-State Analysis of Infiltration and Overland Flow for Spatially-Varied Hillslopes,
W87-08974 2E

UTAH STATE UNIV. LOGAN, DEPT. OF RANGE SCIENCE AND ECOLOGY CENTER.
Water Relations of Xeric Grasses in the Field: Interactions of Mycorrhizzas and Competition,
W87-09341 2I

UTRECHT UNIV. (NETHERLANDS). DEPT. OF GEOCHEMISTRY.
Geochemical Studies in the Drainage Basin of the Rio Vouga, Portugal. IV. Impact of Land Use on the Hydrogeochemistry of Natural Waters in the Vouzela Region,
W87-09207 4C

VANDERBILT UNIV., NASHVILLE, TN. DEPT. OF CHEMISTRY.
Removal of Antimony from Aqueous Systems,
W87-08604 5F

VANDERBILT UNIV., NASHVILLE, TN. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Scale-Up of Activated Sludge and Trickling Filter Processes,
W87-09451 5D

VATNASKIL, REYKAVIK (ICELAND).
Geothermal Reservoir Engineering Experience in Iceland,
W87-08830 6G

VETERANS GENERAL HOSPITAL, TAIPEI (TAIWAN). DEPT. OF MEDICINE.
Hydrogen Sulfide Poisonings in Hot-Spring Reservoir Cleaning: Two Case Reports,
W87-08614 5C

VIRGINIA INST. OF MARINE SCIENCE, GLOUCESTER POINT.
Examination of Tidal Flats, Vol. 1: Research Report.
W87-09492 4C

Examination of Tidal Flats, Vol. 3: Evaluation Methodology.
W87-09493 4C

Effects of Dimethylnaphthalene and Fluctuating Temperatures on Estuarine Shrimp,
W87-09517 5C

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF AGRONOMY.
Finite Element Analysis of Water Flow in Variably Saturated Soil,
W87-08620 2G

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF BIOLOGY.
Factors Influencing Acute Toxicity of Coal Ash to Rainbow Trout (Salmo gairdneri) and Bluegill Sunfish (Lepomis macrochirus),
W87-08978 5C

VIRGINIA UNIV., CHARLOTTESVILLE. DEPT. OF ENVIRONMENTAL SCIENCES.
Mobilization of Aluminum in a Natural Soil System: Effects of Hydrologic Pathways,
W87-09024 5B

Atmospheric Lead and Zinc Deposition into Lakes of the Eastern United States,
W87-09183 5B

VST CONSULTING ENGINEERS, REYKJAVIK (ICELAND).
Groundwater Modelling for Hydropower Development in Iceland,
W87-08829 2F

WABASH COLL., CRAWFORDSVILLE, IN. DEPT. OF BIOLOGY.
Hydrodynamics and Structure: Interactive Effects on Meiofauna Dispersal,
W87-08838 2L

WAHNBACHTALSPERRENVERBAND, SIEGBURG (GERMANY, F.R.).
Scale-Up of Direct Filtration (The Wahnbach System),
W87-09447 5F

WAPORA, INC., CHEVY CHASE, MD.
Ecological Factors in the Selection of Representative Species for Thermal Effluent Demonstrations,
W87-09315 5C

WARREN SPRING LAB., STEVENAGE (ENGLAND).
Use of Dispersants on Viscous Fuel Oils and Water in Crude Oil Emulsions,
W87-09511 5G

WASHINGTON STATE UNIV., PULLMAN. COLL. OF AGRICULTURE RESEARCH CENTER.
Simulation Model for Predicting Effect of Water Stress on Yield: An Example Using Corn,
W87-09470 3F

WASHINGTON UNIV., SEATTLE. QUATERNARY RESEARCH CENTER.
Macrofossil and Pollen Representation of Coniferous Trees In Modern Sediments from Washington,
W87-08690 2H

WASHINGTON UNIV., SEATTLE. SCHOOL OF OCEANOGRAPHY.
Role of Gas Exchange in the Inorganic Carbon, Oxygen, and 222Rn Budgets of the Amazon River,
W87-08871 2H

WATER AND AIR RESEARCH, INC., GAINESVILLE, FL.
Statistical Techniques for Evaluating Procedures and Results for Periphyton Sampling,
W87-09319 7C

Impact of Trinitrotoluene Wastewaters on Aquatic Biota in Lake Chickamauga, Tennessee,
W87-09322 5C

WATER AND POWER RESOURCES SERVICE, DENVER, CO. ENGINEERING AND RESEARCH CENTER.
Foundation Treatment Using Pneumatically Applied Concrete,
W87-09158 8F

Alternative Procedure for Determining the Shrinkage Limit of Soil,
W87-09159 2G

Biological Control of Aquatic Weeds: The Efficacy of Hybrid Grass Carp in Two Southern California Irrigation Canals,
W87-09480 4A

WATER RESEARCH CENTRE, STEVENAGE (ENGLAND).
Scale-Up of Biological Wastewater Treatment Processes: Practical Experiences in the U.K.,
W87-09453 5D

WATER RESOURCES COMMISSION, SYDNEY (AUSTRALIA).
Hydrogeological Aspects of Coal Mining Under Stored Waters Near Sydney, Australia,
W87-09587 2F

WATERLOO UNIV. (ONTARIO). CENTRE FOR PROCESS DEVELOPMENT.
Scale-Up Experience with the Waterloo SCP Process in Industrial Biomass Waste Treatment,
W87-09455 5D

WATERLOO UNIV. (ONTARIO). DEPT. OF EARTH SCIENCES.
Simulation of the Borden Plume Using the Alternating Direction Galerkin Technique,
W87-09030 5B

WATERLOOPKUNDIG LAB. TE DELFT (NETHERLANDS).
Analysis of Horizontally Two-Dimensional Morphological Evolutions in Shallow Water,
W87-08782 7C

WEIZMANN INST. OF SCIENCE, REHOVOT (ISRAEL). DEPT. OF ISOTOPE RESEARCH.
Surface Manifestations of Internal Oscillations in a Highly Saline Lake (the Dead Sea),
W87-08866 2H

WESTERN ARCHAEOLOGICAL CONSULTANTS, INC., BOULDER, CO.
Archaeological and Historical Surveys of Selected Portions of the Umatilla Basin Project, Umatilla County, Oregon,
W87-09425 6G

WESTERN WASHINGTON RESEARCH AND EXTENSION CENTER, WASHINGTON STATE UNIV., PUYALLUP, WASH. 98371-4998.
Influence of Soil Characteristics and Environmental Conditions on Seasonal Variations of Water-Soluble Phosphate in Soils,
W87-09257 2G

WESTON (ROY F.), INC., WEST CHESTER, PA.
Method for Evaluating the Impact of Radioactivity on Phytoplankton,
W87-09317 5C

WHATAWHATA HILL COUNTRY RESEARCH STATION, HAMILTON (NEW ZEALAND).
Soil Water Balance Model for Sloping Land,
W87-08735 2A

WINDSOR UNIV. (ONTARIO). DEPT. OF BIOLOGY.
Ecological and Physiological Differentiation Among Low-Arctic Clones of Daphnia Pulex,
W87-08691 2H

WINONA STATE UNIV., MN. DEPT. OF BIOLOGY.
Impacts of a Spill of No. 6 Fuel Oil on Lake Winona,
W87-09551 5C

WISCONSIN-MADISON UNIV. DEPT. OF FORESTRY.
Effects of Flooding, Tilting of Stems, and Ethrel Application on Growth, Stem Anatomy and Ethylene Production of Pinus Densiflora Seedlings,
W87-08797 2I

WISCONSIN UNIV.-MADISON.
Introduction to Groundwater Modeling: Finite Difference and Finite Element Methods,
W87-08684 2F

WISCONSIN UNIV.-MADISON. COLL. OF AGRICULTURAL AND LIFE SCIENCES.
Soil Clogging During Subsurface Wastewater Infiltration as Affected by Effluent Composition and Loading Rate,
W87-08928 5C

WISCONSIN UNIV.-MADISON. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Estimating Baseflow Volume and its Uncertainty,
W87-08971 2E

WISCONSIN UNIV.-MADISON. DEPT. OF SOIL SCIENCE.
Effect of Tillage System on Runoff Losses of Surface-Applied Pesticides,
W87-09001 2E

WISCONSIN UNIV.-MADISON. WATER CHEMISTRY LAB.
Atmospheric Deposition of Particulate Organic Carbon and Polyaromatic Hydrocarbons to Lake Michigan,
W87-09187 5B

WOODS HOLE OCEANOGRAPHIC INSTITUTION, MA.
Carbon Isotope Fractionation and Changes in the Flux and Composition of Particulate Matter Resulting from Biological Activity during a Sediment Trap Experiment in Lake Greifen, Switzerland,
W87-08867 2H

WOODWARD-CLYDE CONSULTANTS, VICTORIA (BRITISH COLUMBIA).
Spill Impacts and Shoreline Cleanup Operations on Arctic and Sub-Arctic Coasts,
W87-09538 5G

WORLD HEALTH ORGANIZATION, GENEVA (SWITZERLAND). DIV. OF NONCOMMUNICABLE DISEASES.
Geochemistry, Soils and Cardiovascular Diseases,
W87-08692 2F

WURZBURG UNIV. (GERMANY, F.R.). LEHRSTUHL FUR BOTANIK II.
Water Vapor Uptake and Photosynthesis of Lichens: Performance Differences in Species with Green and Blue-Green Algae as Phycobionts,
W87-09345 2I

WYOMING UNIV., LARAMIE. DEPT. OF ZOOLOGY AND PHYSIOLOGY.
Effect of Beaver Ponds on the Nonpoint Source Water Quality of a Stream in Southwestern Wyoming,
W87-09265 2H

WYOMING WATER DEVELOPMENT COMMISSION.
Small-Scale Hydroelectric Power.
W87-09110 6A

YALE UNIV., NEW HAVEN, CT. DEPT. OF BIOLOGY.
Decrease in Precipitation Acidity Resulting From Decreased S04(2-) Concentration,
W87-09348 5B

YALE UNIV., NEW HAVEN, CT. SCHOOL OF FORESTRY AND ENVIRONMENTAL STUDIES.
Modeling the Demand for Outdoor Recreation,
W87-09034 6D

ZIMBABWE UNIV., MOUNT PLEASANT. DEPT. OF LAND MANAGEMENT.
Biological Denitrification of a Highly Nitrogenous Industrial Effluent: A Case Study in Zimbabwe,
W87-08964 5D

ZOOLOGICAL INST., UNIV. OF MUNICH; SEIDLSTRASS 25, D-8000 MUNCHEN 2, FEDERAL REPUBLIC OF GERMANY.
Dispersal-Mediated Coexistence of Mud Snails (Hydrobiidae) in an Estuary,
W87-09422 2L

ZWECKVERBAND BODENSEEWASSERVERSORGUNG UBERLINGEN-SUSSENMUHLE (GERMANY, F.R.).
Microflocculation by Ozone,
W87-09142 5F

ACCESSION NUMBER INDEX

W87-08601 5F
W87-08602 5D
W87-08603 5D
W87-08604 5F
W87-08605 5D
W87-08606 5D
W87-08607 8A
W87-08608 8A
W87-08609 5D
W87-08610 4A
W87-08611 1B
W87-08612 5A
W87-08613 5C
W87-08614 5C
W87-08615 2F
W87-08616 2E
W87-08617 2F
W87-08618 2F
W87-08619 7C
W87-08620 2G
W87-08621 2I
W87-08622 2A
W87-08623 7B
W87-08624 6E
W87-08625 6E
W87-08626 6E
W87-08627 6E
W87-08628 5G
W87-08629 5G
W87-08630 5C
W87-08631 5C
W87-08632 5A
W87-08633 5C
W87-08634 5C
W87-08635 5C
W87-08636 5G
W87-08637 5C
W87-08638 5C
W87-08639 5C
W87-08640 5C
W87-08641 2H
W87-08642 5C
W87-08643 5C
W87-08644 5C
W87-08645 5A
W87-08646 5A
W87-08647 5C
W87-08648 5C
W87-08649 7B
W87-08650 5C
W87-08651 5C
W87-08652 5C
W87-08653 5C
W87-08654 5C
W87-08655 5C
W87-08656 5C
W87-08657 5B
W87-08658 5B
W87-08659 5B
W87-08660 5B
W87-08661 3F
W87-08662 2A
W87-08663 2J
W87-08664 3F
W87-08665 3F
W87-08666 8A
W87-08667 3F
W87-08668 3F
W87-08669 3F
W87-08670 5B
W87-08671 5B
W87-08672 5B
W87-08673 5B
W87-08674 4D
W87-08675 5B
W87-08676 5B
W87-08677 5B
W87-08678 5B
W87-08679 5B
W87-08680 5B
W87-08681 5B
W87-08682 5B
W87-08683 5B
W87-08684 2F
W87-08685 2A
W87-08686 4D
W87-08687 2F
W87-08688 8B
W87-08689 2G
W87-08690 2H
W87-08691 2H
W87-08692 2F
W87-08693 2K
W87-08694 5C
W87-08695 2B
W87-08696 2C
W87-08697 2B
W87-08698 2B
W87-08699 2A
W87-08700 2B
W87-08701 2B
W87-08702 2B
W87-08703 5C
W87-08704 5F
W87-08705 2I
W87-08706 2F
W87-08707 2I
W87-08708 6G
W87-08709 2H
W87-08710 5B
W87-08711 2H
W87-08712 2H
W87-08713 5C
W87-08714 2H
W87-08715 2H
W87-08716 2K
W87-08717 2L
W87-08718 5B
W87-08719 2K
W87-08720 2K
W87-08721 2H
W87-08722 2K
W87-08723 5A
W87-08724 5B
W87-08725 5D
W87-08726 5B
W87-08727 5B
W87-08728 5B
W87-08729 5B
W87-08730 5B
W87-08731 5B
W87-08732 5B
W87-08733 5A
W87-08734 2J
W87-08735 2A
W87-08736 2G
W87-08737 5B
W87-08738 3B
W87-08739 3F
W87-08740 3F
W87-08741 5G
W87-08742 4D
W87-08743 2D
W87-08744 3F
W87-08745 5G
W87-08746 3C
W87-08747 3C
W87-08748 3F
W87-08749 6G
W87-08750 3F
W87-08751 5B
W87-08752 5B
W87-08753 2F
W87-08754 2F
W87-08755 7B
W87-08756 7C
W87-08757 5B
W87-08758 2F
W87-08759 5B
W87-08760 7C
W87-08761 2H
W87-08762 2H
W87-08763 2H
W87-08764 2H
W87-08765 5C
W87-08766 2H
W87-08767 2H
W87-08768 2H
W87-08769 7B
W87-08770 2I
W87-08771 5D
W87-08772 2I
W87-08773 2G
W87-08774 5D
W87-08775 2B
W87-08776 5E
W87-08777 5F
W87-08778 5F
W87-08779 5G
W87-08780 2H
W87-08781 2G
W87-08782 7C
W87-08783 2I
W87-08784 6A
W87-08785 2H
W87-08786 2H
W87-08787 2L
W87-08788 3F
W87-08789 5C
W87-08790 2H
W87-08791 2G
W87-08792 2H
W87-08793 2H
W87-08794 8A
W87-08795 8A
W87-08796 2G
W87-08797 2I
W87-08798 2I
W87-08799 2H
W87-08800 2B
W87-08801 5F
W87-08802 5D
W87-08803 5E
W87-08804 2J
W87-08805 5E
W87-08806 2I
W87-08807 5F
W87-08808 5E
W87-08809 2B
W87-08810 2C
W87-08811 2E
W87-08812 7C
W87-08813 2B
W87-08814 2B
W87-08815 2G
W87-08816 2G
W87-08817 2G
W87-08818 5B
W87-08819 5B
W87-08820 5B
W87-08821 2A
W87-08822 2E
W87-08823 2G
W87-08824 2E
W87-08825 2E
W87-08826 2E
W87-08827 2E
W87-08828 2H
W87-08829 2F
W87-08830 6G
W87-08831 5A
W87-08832 5A
W87-08833 5A
W87-08834 2E
W87-08835 5C
W87-08836 2H
W87-08837 2H
W87-08838 2L
W87-08839 2L
W87-08840 5C
W87-08841 5C
W87-08842 5C
W87-08843 5C
W87-08844 5C
W87-08845 5A
W87-08846 2H
W87-08847 2D
W87-08848 2D
W87-08849 2L
W87-08850 5C
W87-08851 5C
W87-08852 5C
W87-08853 5B
W87-08854 5C
W87-08855 5C
W87-08856 5B
W87-08857 5C
W87-08858 5C
W87-08859 5B
W87-08860 5B
W87-08861 5B
W87-08862 2L
W87-08863 2H
W87-08864 2H
W87-08865 2H
W87-08866 2H
W87-08867 2H
W87-08868 2H
W87-08869 5B
W87-08870 2H
W87-08871 2H
W87-08872 2H
W87-08873 5C
W87-08874 5C
W87-08875 5A
W87-08876 5C
W87-08877 5C
W87-08878 5B
W87-08879 5C
W87-08880 5B
W87-08881 5C
W87-08882 5C
W87-08883 2H
W87-08884 5A
W87-08885 5A
W87-08886 5C
W87-08887 5A
W87-08888 5B
W87-08889 5D
W87-08890 5D
W87-08891 5E
W87-08892 2G
W87-08893 2D
W87-08894 5A
W87-08895 5A
W87-08896 5A
W87-08897 5B
W87-08898 5A
W87-08899 5B
W87-08900 2H
W87-08901 5F
W87-08902 2H
W87-08903 5A
W87-08904 5F
W87-08905 5F
W87-08906 5F
W87-08907 5B
W87-08908 5C
W87-08909 2H
W87-08910 5B
W87-08911 5B
W87-08912 5B
W87-08913 5A
W87-08914 5A
W87-08915 5B
W87-08916 5B
W87-08917 5B
W87-08918 5A
W87-08919 5C
W87-08920 5C
W87-08921 5C
W87-08922 5C
W87-08923 5A
W87-08924 2J
W87-08925 5B
W87-08926 5B
W87-08927 5C
W87-08928 5C
W87-08929 2H
W87-08930 2H
W87-08931 2H
W87-08932 2L
W87-08933 2L
W87-08934 2H
W87-08935 7B
W87-08936 2H

W87-08937 2B
W87-08938 2B
W87-08939 2B
W87-08940 2B
W87-08941 2B
W87-08942 5B
W87-08943 2B
W87-08944 2B
W87-08945 5B
W87-08946 5B
W87-08947 2C
W87-08948 7B
W87-08949 7B
W87-08950 6E
W87-08951 5F
W87-08952 5F
W87-08953 5F
W87-08954 5F
W87-08955 6C
W87-08956 5F
W87-08957 5F
W87-08958 5A
W87-08959 5F
W87-08960 7B
W87-08961 5A
W87-08962 5C
W87-08963 5C
W87-08964 5D
W87-08965 2E
W87-08966 2H
W87-08967 2F
W87-08968 6C
W87-08969 2J
W87-08970 7B
W87-08971 2E
W87-08972 2H
W87-08973 2H
W87-08974 2E
W87-08975 2H
W87-08976 2E
W87-08977 7A
W87-08978 5C
W87-08979 2F
W87-08980 2E
W87-08981 6A
W87-08982 5G
W87-08983 7B
W87-08984 6C
W87-08985 5A
W87-08986 5A
W87-08987 2L
W87-08988 2L
W87-08989 7B
W87-08990 7C
W87-08991 7B
W87-08992 2G
W87-08993 2G
W87-08994 7C
W87-08995 2G
W87-08996 2G
W87-08997 5C
W87-08998 2H
W87-08999 2H
W87-09000 2J
W87-09001 2E
W87-09002 4A
W87-09003 3F
W87-09004 2J
W87-09005 2G
W87-09006 2D
W87-09007 7B
W87-09008 5B
W87-09009 2G
W87-09010 7B
W87-09011 5A
W87-09012 7B
W87-09013 5G
W87-09014 6D
W87-09015 3F
W87-09016 2J
W87-09017 5B
W87-09018 2F
W87-09019 2G
W87-09020 2G
W87-09021 7B
W87-09022 7C
W87-09023 7C
W87-09024 5B
W87-09025 7C
W87-09026 7C
W87-09027 5B
W87-09028 2I
W87-09029 7C
W87-09030 5B
W87-09031 6C
W87-09032 6B
W87-09033 6C
W87-09034 6D
W87-09035 5B
W87-09036 4C
W87-09037 2H
W87-09038 6G
W87-09039 6G
W87-09040 6G
W87-09041 6G
W87-09042 2H
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Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

7 RESOURCES DATA

8 ENGINEERING WORKS

9 MANPOWER, GRANTS, AND FACILITIES

10 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

SUBJECT INDEX

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